The Science Teacher

OTIS WILLIAM CALDWELL
1869-1947

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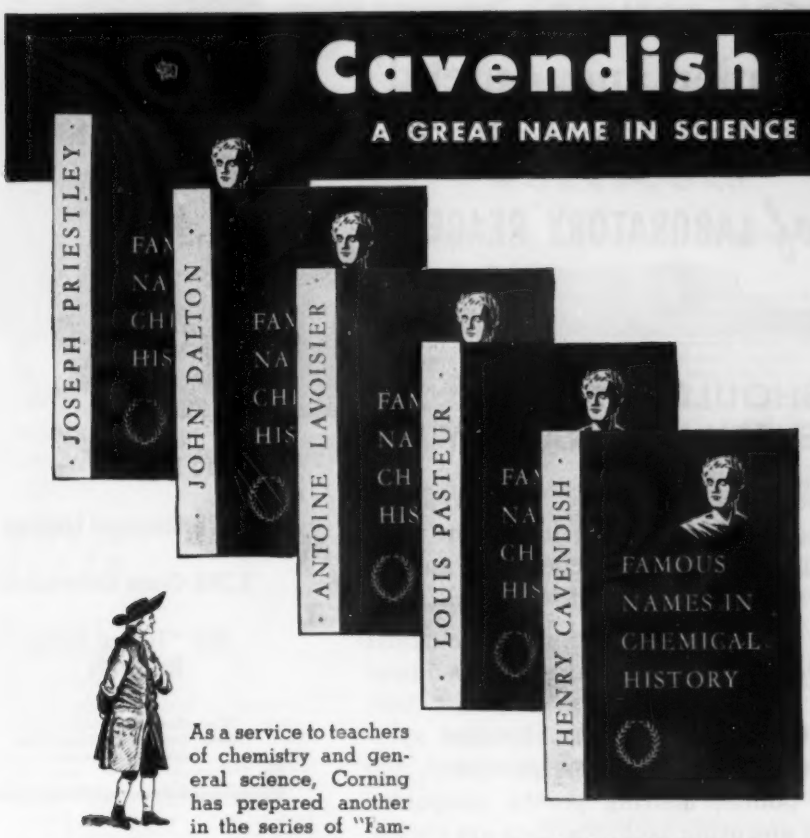

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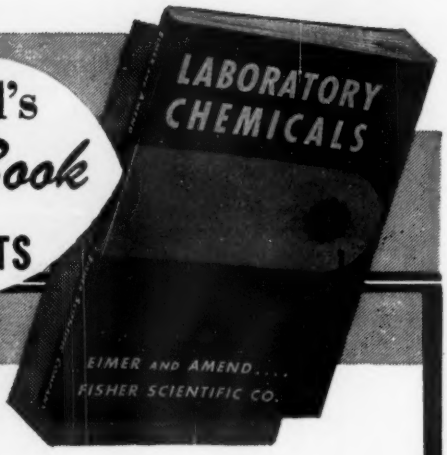

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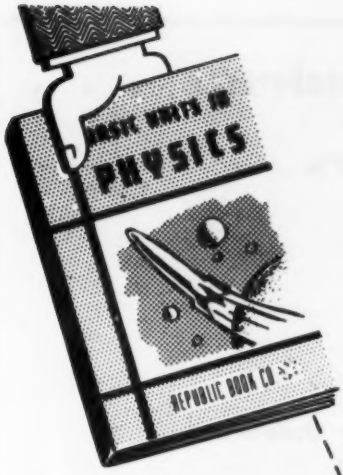

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Proposals of the National Committee on Policies in Conservation Education

JOHN W. SCOTT
Chairman
National Committee on Policies

AN ACCOUNT of the origin, purpose and activities of this committee is appropriate. Less than a century ago our natural resources seemed inexhaustible. Shortly after the Civil War, a group of scientists vainly called attention to the wastage of national resources, but it was not until 1890 that Congress established the first National Forest Preserves, for watershed protection and timber production.

Today, after the second World War, we are keenly aware of the depletion of our forests, felt as a shortage, and high cost of building materials and paper. Accelerated erosion of top soils is rapidly destroying fertility of farm lands. Pollution of streams and lakes by sewage and industrial wastes has become a national disgrace, a menace to human health and a destruction to aquatic life. With many of our mineral resources approaching exhaustion, with many species of wild life greatly depleted or rapidly disappearing, we keenly realize that the resources upon which our civilization depends have been dissipated probably faster than in any other country in history.

ONE OF the avowed objectives of the League is "To promote means and opportunities for the education of the public with respect to such resources and the enjoyment and wholesome utilization thereof." To put this idea into effect the Executive Board of the League in 1945 organized a committee on conservation education, consisting of educators, scientists and conservationists, with two primary objectives: (1) To formulate the objectives of a national policy of conservation education, and (2) to devise ways and means by which this policy can become a vital part of the school program.

Three meetings of the committee have been held. A progress report was presented before a National Convention of the League March 28, 1946, and published under the title "A National Policy of Conservation Education." The substance of this report was presented before a meeting of the National Association of Biology Teachers, March 30, 1946, and in September an article was published in the Science Counselor.

In a recent publication, entitled "Proposals for Formulating National Policies in Conservation Education" the committee has a plan of work which is here presented in abbreviated form.

SINCE the exploitation and misuse of land, water, and other natural and human resources jeopardize the life interest of present and future generations in the National Estate, the Committee proposes to study, formulate, and seek implementation of a coordinated, comprehensive program of conservation education.

The Committee proposes to concern itself with these major objectives: 1. An understanding of man's relation to his environment, including all natural resources; 2. An understanding of man's responsibility in cooperating with nature to preserve his own desirable environment; 3. Universal responsibility of citizens to use wisely and preserve natural resources for the common good; 4. A realization of the necessity for immediate action.

To meet these objectives the National Committee seeks the cooperation and collaboration

of all agencies and individuals interested in the formulation of a statement of national policy and means for carrying it into effect. The committee will not attempt to duplicate the work of present agencies and groups, but rather to focus attention on programs and policies which will promote the most effective means of developing conservation education at all school levels.

The National Committee tentatively suggests the following general principles for consideration: 1. Conservation is a theme which should have a place in the development of all good citizenship, and as such should appear in the curriculum of all schools, at all levels. It is equally important to both rural and urban centers. The essential knowledges and attitudes concerning conservation can best be integrated into the school curriculum at elementary and high school levels. In college and professional schools both integration and specific courses are required to meet specific needs. Coordination and collaboration of effort by private and public groups of an educational, scientific, conservation and civic character, should be emphasized on all levels;—i.e. local, state, national, and international. In view of the urgency of conservation, it is essential that programs for the education of adults be included so that proper attitudes, background and understanding can be developed to create the necessary public opinion both for sound conservation practices and for the support of conservation education as an essential part of the schools' program.

(2) As a guiding principle conservation education may best be based on experiences that deal with local realities significant to the learner, that recognize the relationship between cause and effect, and the need of linking individual behavior with social responsibility. An adequate program must recognize the need of integrating the resource-use of different geographic areas, and individuals of different economic and social success, through the employment of various educational procedures in the various significant areas of human understanding. It also should be recognized that conservation education is best carried out in a school and community climate where there are well-trained teachers and leaders interested in the growth and development of children, sensitive to social needs, and provided with the working conditions necessary for effective, democratic education.

(3) Adequate emphasis should be placed on the wise use of our resources, including all the fundamental areas of soil conservation, water, all wildlife (both animal and plant), forests, grasses, minerals, recreational, scenic, and human resources.

(4) The objectives of conservation education are to create attitudes, background and knowledge which will result in action on the part of citizens: To protect and maintain natural and human resources; to improve natural resources by making them more productive; to insure the wise use of natural resources; and to provide future generations with their rightful heritage. Adequate conservation education must be accompanied by inventory, research, wise use and renewal.

(5) Visualized education, in the form of first hand experiences with natural environment, should be an essential part of the professional pre-service and in-service education for teachers. Likewise the curriculum for children should embody environmental experience, camping, field trips, soil testing, planned care of plant and animal life, supplemented by such significant experiences as may be participated in by laymen, teachers, and pupils. Such experiences are essential to development of a truly motivating conservation education program.

(6) Continuous technical research is needed to establish and to improve good conservation practices; to determine the techniques and procedures essential for putting conservation practices into effect; and to make technical studies as well as those directed towards the preparation of appropriate instructional materials.

(7) The effectiveness of a conservation education program may be recognized in part by the production of adequate instructional materials suitable for use in school and out that bring about the desired objectives. Effectiveness is further characterized by general public support, by adequate financial and legislative support, by support of practices identified with maintaining the maximum benefits, and possible rewards, through wise use of our natural resources. *Continued on Page 144*

How to Increase Natural Resource-Planning*

PHILIP G. JOHNSON
U. S. Office of Education
Washington, D. C.

IN MY definition of natural resources, I am including wildlife—"flesh, fish, fowl" and other animals, and plants; minerals—ores, soils, water, air, or other elements compounds and mixtures; and energy—heat, light, electricity, and the like. I intend to reveal some details relating to certain general procedures which can be applied to the improvement of instruction in any and all subject matter areas, but I shall try to limit my illustrations to physics and chemistry and the physical and chemical aspects of other elementary and secondary school subjects.

There are numerous procedures by which we may increase our natural resources planning and conservation education through the physical sciences. All of these may be related to pre-service and in-service education programs. Of these two, I am most interested in the in-service procedures because such procedures will most immediately influence educational practices and also because of the effects such influences will have upon the pre-service training programs.

Since the public schools constitute our greatest educational agency we should give special consideration to the needs of elementary and secondary school teachers, but we must also have in mind the influencing of staff members in Teachers Colleges, Liberal Arts Colleges and Universities, as well as many State and Federal employees who are not directly concerned with teaching. Then we should also consider a number of other persons who work with, through, and for the schools from a variety of organizations, associations, foundations, and industries. In short we need to consider all persons who directly or indirectly assist, guide or direct the in-service and pre-service education of teachers. Our real problem is one of devicing and putting into action the procedures that will bring available knowledge and "know-how" to teachers in a form which they can readily use. As a group whose interests are largely scientific, it may be appropriate to mention that we must keep in mind that we cannot confine ourselves to the workers in the six areas set up in this program if we wish to avail ourselves of all the significant channels for winning the proper friends and influencing the proper people. English teachers, vocational agriculture teachers, and the administrative workers should also be considered.

ONE OF THE procedures that we commonly think about when we wish to stimulate cooperative action is a joint meeting or joint conference. If nothing more is involved than some kind of a joint meeting at which ideas are exchanged, I would dismiss this procedure as of but little worth. I do not expect that my comments on this program will either increase or decrease resource planning or conservation education very much. I do have hopes that my suggestions relating to other procedures will be taken seriously and applied.

What are some possible and promising types of procedures which we should plan for in promoting the cause we are considering together this morning? I will confine myself largely to work-conferences, work-shops, resources-use unit development, and on-the-job experience.

IT IS MY judgment that work-conferences can greatly increase resource planning and conservation education if they are carefully pre-planned. By this I mean that certain few interested persons will do much work well in advance of the actual conference. They will select a vital theme and they will try to find a generous sponsor; they will develop a clear project proposal and win the cooperation and support of the sponsor; they will draw up statements of the related problems, they will outline the answers to these problems; they will arrange for manuscripts which will present the answers along with vivid illustrations; they will get these manuscripts reproduced and distributed for thorough criticism by a number of competent persons; they

Continued on Page 133

*Presented at The American Nature Study Society Meeting, Boston, Mass., December 27, 1946.

President's Page — By Morris Meister

Otis William Caldwell

THE NEWS of Dr. Caldwell's death on July 5, 1947, reached the Board of Directors of the National Science Teachers Association while they were in session in Cincinnati. Appropriate action was taken, yet business and discussion could not quite continue as before. Reflected in the words and mien of every Director present was the sense of shock and loss which science education has suffered.

For half a century, Otis Caldwell gave every ounce of his abundant energies and every facet of his fine mind to the problems of our profession. His life blazed a trail to which thousands were attracted. Every great advance in science teaching during the past five decades is intimately associated with his name.

Trained as a botanist, he knew well the part that biological science can play in the education of children. He knew, too, that the essence of this contribution is to be found in all the sciences. With true vision he threw himself into the General Science movement, bringing it to fruition in the schools of the nation.

In 1920, Dr. Caldwell as chairman of the Committee on Science of the Commission on The Reorganization of Secondary Education crystallized the pattern of the science curriculum. In this report, science teachers could see clearly for the first time, a sequence of science studies that gave dignity and scope to their efforts. It was Dr. Caldwell again who showed the way in extrapolating that sequence to include the elementary school at one end and the junior college at the other. That same philosophy and vision is given even fuller and more modern scope in the capstone chapter written by him in the recent Forty-Sixth Yearbook on Science Education in American Schools.

Dr. Caldwell's concern with "science in our lives" led him early to an examination of newspapers, magazines and world affairs. His now famous study, "Biology in the Public Press," was a pioneering effort that touched off many similar surveys. At his death, he was chairman of the AAAS Westinghouse Committee on Science Writers Awards, a project which now helps to bring good science to all the people.

SCIENCE was a way of life to Dr. Caldwell. He could not and would not tolerate prejudiced thinking. What, then, should be done to rid the world of such thinking? The typical Caldwellian answer can be found in his two widely read books: "Science Remaking the World" and "Do You Believe It?" In the first, he asks that "intellectual and moral ideas shall develop in harmony with modern science." In the second, he subjects man's common superstitions to the cold blazing light of scientific reason.

Those of us who are today still fighting for adequate representation of science in the curriculum can understand why Dr. Caldwell seized the opportunity of directing a school. The Lincoln School of Teachers College is world famous. Conceived by the Caldwell mind, it lighted a flame which is still burning vigorously in all curriculum laboratories. The Lincoln School placed science at the core of the educative process. Its curriculum determined the physical plant which was built according to the Caldwell blueprint. He gathered a great faculty of broadly educated and competent men and women who became the living examples of a sound program of teacher training. In that school, science was much more than a subject to be taught; it was a phase of life to be integrated with all other aspects of child experience.

When Dr. Caldwell retired from his post at Teachers College, he indulged his earliest interest by returning to the work of laboratory scientists at the Boyce Thompson Institute for Plant Research. From that vantage point he carried on as General Secretary of the AAAS, where his matured philosophy of science education found new outlets and widened scope. He organized the AAAS Committee on the Place of Science in Education, which won over the scientists of the nation to the need for better science teaching in the schools. He stimulated the growth of the Jun-

Continued on next page

This and That

NORMAN R. D. JONES
Vice-President and Membership Chairman

Among the new "Fellows" elected by the A. A. A. S. at Boston is Greta Appe, Head of the Science Department, Ball High School, Galveston, Texas and regional vice-president of N. S. T. A.

Robert H. Carleton will work towards his "Doctorate'" at Michigan State College of East Lansing. As an Assistant Professor of Physical Science, he can work more closely in his field of interest, "Science for General Education."

Myrtie O'Steen Baker, N. S. T. A. Area Director of Atlanta, Georgia, was elected president of the State Science Section of the Georgia Educational Association at its spring meeting.

Robert K. Molkenbur, 337 Forrest, St. Paul, Minn., was elected president of the Minnesota Junior Academy of Science.

The Dick Weavers are now located at Chapel Hill, N. C. Mr. Weaver is the Associate Director of the N. C. Resource Use Education Commission.

Charles Mohr, of Philadelphia, has succeeded Mr. Weaver at the Audubon Nature Camp at Greenwich, Conn.

J. Karlen Reiss, of Tulane University, was elected treasurer of the New Orleans Academy of Sciences at its 94th annual meeting in April.

L. A. Pinkney was recently made Supervisor of the Department of Visual Education at Kansas City, Mo.

Dr. Philip G. Johnson of the U. S. Office of Education and immediate past-president of N. S. T. A., conducted summer workshops in Logan, Utah; Minneapolis, Minn.; and Syracuse, N. Y.

C. W. DeWalt of Glenn Ellyn was elected president of the Illinois Association of Chemistry Teachers at its spring meeting.

Walter D. Tallman, N. S. T. A. Area Director from South Eastern Ohio, will be located at Ashland this year. Mr. Tallman was married this past summer. Congratulations.

Renew Now Please

This is the last issue of "The Science Teacher" on your 1946-7 membership. If you have not already done so, please send us your $2.00 for your 1947-8 membership immediately. Also, it would be appreciated if you would solicit memberships from your co-workers. N. S. T. A. can be of greater service only as its membership increases.

December—A.A.A.S. Meeting

Have you made your reservations? You will want to be present for this fine meeting to be held in Chicago, December 27-30. Why not start immediately to plan to be present?

Science Talent Search

It is hoped that as many of you as possible will urge and assist your pupils in entering the Westinghouse Science Talent Search sponsored by Science Clubs of America.

Continued on next page

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ior Academies of Science. He brought into being the AAAS Cooperative Committee on Science Teaching. He developed the Committee on the Junior Scientists Assembly. He founded the American Science Teachers Association, the progenitor of NSTA.

WE, IN NSTA, owe much to Dr. Caldwell. Through his intercession, we were welcomed into the family of AAAS affiliates. Our program of activities was inspired by him. He helped us with invaluable counsel and with financial aid about which he wished no public mention. He turned over to us some of the most important educational projects. He was made happy by our rapid growth and daydreamed about our rosy future. In a very real sense, he was our patron saint.

We can render no better tribute to the memory of this great science educator than by dedicating ourselves with renewed vigor to the objectives of NSTA—which are written in the image of Otis Caldwell.

Morris Meister,
President, NSTA.

New Directors

Mr. Harold E. Eaton, 565 Clark St., Morgantown, W. Va.

Membership Goal

Stanley E. Williamson, Oregon N. S. T. A. Director, exceeded his 200% increase goal of last year. How much better can we make our record this year?

Legislation

The National Science Foundation bill was passed by both the Senate and House but was vetoed by President Truman. Urge your legislators to action on it at the next session of Congress.

1947 Yearbook

The "Work Week of the Science Teacher" will be off the press about the last of November (barring unforeseen difficulties). The Board of Directors voted to call this type of publication a "Bulletin" here-after.

Recent Affiliations

We are happy to welcome the following organizations to our ever growing list of "Affiliates"

New York Chemistry Teachers Club
Association De Maestros (Puerto Rico)
Physics Club of New York City

Changes of Address

Some recent changes of address are:

Ellen M. Johnson to Denver, Colo.; L. H. Bryant to Calistoga, Calif.; Dr. George C. Wood to Barneveld, N. Y.; A. W. Strepek to U. of Illinois at Galesburg, Illinois; Leon Greenwald to Goshen, Ind.; Mrs. E. Schulz to Hopkins, Mo.; Bess F. Whitney to Miltonvale, Kan.; Charles D. Baker to Pendleton, Ore.; Doris Pauline Baxter to Alva, Okla.; Frances Allen to Colony, Okla.; Davida Phillips, Stillwater, Okla.; Paul J. Malie to Pittsburgh, Pa.; Alfred M. Ewing to U. of Mississippi at Oxford.

San Diego—A.A.A.S. Meeting

The California groups deserve a great deal of credit for the excellent meeting which they put on at the A. A. A. S. Pacific Division Meeting in San Diego last June.

Due to great distances in California it was deemed advisable to form a third major organization in California with a State Council to coordinate their work.

Temporary officers directed to prepare proposals for a permanent organization in the San Diego area are: Adrian N. Gentry, president; Miss Winifred Perry, vice-president; Miss Hildegarde Hartig, secretary-treasurer, and John C. Lamont and Lowell H. Pierce, members of the executive board.

Puerto Rico S. T. A. Officers

President: Mrs. Josefina Martineg; Vice-presidents: Mrs. Julia C. de Santiago, Mrs. Providencia Lopez, and Mrs. Julio Garcia Diez; Secretary-Treasurer: Mrs. Nereida de Planell; Board of Directors: Mrs. Angelina Rousset, Mr. Javier Vanga, Mrs. Florde Maria Pardo, and Miss Irina Arenas; Advisers: Mrs. Maria A. Ruiz and Sr. L. Lebron Ortiz.

Mr. Ortiz, the retiring president, has ably served this organization for the past several years. He was instrumental in bringing about the affiliation of the P. R. S. T. Association with N. S. T. A.

Nebraska S. T. Ass'n Reorganized

The Nebraska Science Teachers Association, inactive during the war, was reorganized at a meeting held in conjunction with the Nebraska Academy of Science meeting last May. The officers elected were: President, Allan M. Maker, Norfolk; Vice-president, Kenneth Howland, Hastings; Secretary, Harold E. Wise, U. of Nebraska, Lincoln; Treasurer, Roy E. Busch, Omaha; Consultant, Ellis M. Jeffery, Lincoln.

Mr. J. D. Young of Lincoln was elected chairman for the Nebraska Junior Academy of Science and Dr. H. E. Wise, Secretary.

New Directors

Keith Johnson, Woodrow Wilson High School, Washington 6, D. C.

News

Emil Massey, Harold Eaton, and Norman R. D. Jones represented N.S.T.A. at the National Safety Commission-NSTA Conference held August 28-30 at Jackson's Mill, W. Va. in the preparation of a safety pamphlet for Elementary Science Teachers.

Irving E. Blume, Central Ohio Director, of Columbus, served as Ranger-Naturalist on the Staff of Yellowstone National Park, Wyoming this past summer.

Nathan A. Neal, treasurer of NSTA, is doing advanced graduate work at Columbia University.

Order in the Department

ADDISON LEE
University of Texas

THE WORD "Science" is commonly defined using such terms as classification and systematic arrangement. Yet many a new teacher or a visitor has walked into the science room or department and found the materials and equipment in a considerable state of disorder —evidence of the lack of application of the meaning of these terms to the physical assets of the department. In the interest of upholding the increasing responsibilities of science teaching, this is a problem which can and must be solved. It will require initiative and extra effort to start with, but considerable time can be saved later and greater teaching effectiveness accomplished if a well organized system is developed for getting, maintaining, and using science material and equipment. The purpose of this discussion, therefore, is to consider some of the implications of this problem and to offer some suggestions relating to it. It is based on the idea that such organization constitutes one of the basic necessities, along with a sound curriculum and a good teacher, for effective science teaching.

The development of such a program requires support from our administrators—support in the matter of time for our work; support in the matter of funds for basic needs for materials and equipment; and support in the form of confidence in our ability to use both time and funds intelligently and effectively. Colleges and universities should supply, along with training in subject matter, training which will aid teachers in getting, maintaining and using science materials and equipment. Since many teachers in our secondary schools are teaching science with little science training or background, this is a significant need at this time.

Fig. 2. Preserved specimens are conveniently stored in crocks or jars on a movable platform.

Fig. 1. Slide boxes are arranged on shelves and catalogued.

In the actual development of the program, two principal steps must be considered: (1) The organization of supplies and equipment in storerooms and classrooms, and (2) the delivery of supplies and equipment from one room to another. To accomplish these, a definite plan should be worked out to fit the local situation. It might be well to base it on the axiom of the architect "A place for everything and everything in its place." The plan should allow for expansion as new materials and equipment are added. Equipment and supplies should be properly protected. The plan should also call for an arrangement that makes the supplies and equipment as accessible as possible, and the arrangement as neat and attractive as possible. Responsibilities should be clearly defined for the keeping of store-

rooms and delivery of supplies and equipment to the places they are needed as well as returning them to the proper place. The use of interested student assistants for part of this work can be effectively made.

SHELVES in rooms and storerooms can be numbered or lettered and a catalogue made which makes the location of materials and equipment easy. If there is a place for everything and everything in its place, it greatly facilitates the use of student assistants in getting out equipment and returning it, which will in the long run save a remarkable amount of the teacher's time and energy. For the innumerable small items which the department has such as test tubes, petri dishes, stoppers, clamps, etc., it may be useful to construct a number of wooden boxes the right size for the materials and made to fit the shelves. A collection of cigar boxes is also useful for storing small items. If several storerooms are used it may be useful to paint the ends of all the boxes which go in one storeroom a different color from those which go in another storeroom. In this way you can tell at a glance to which storeroom the box should be returned. It is often time saving in the long run to box up kits of certain materials needed for a specific experiment and label it for that experiment. If closed cabinets for the protection of such equipment as microscopes, projectors, physics apparatus, etc., are not available, cloth bags to cover them when not in use could easily be made.

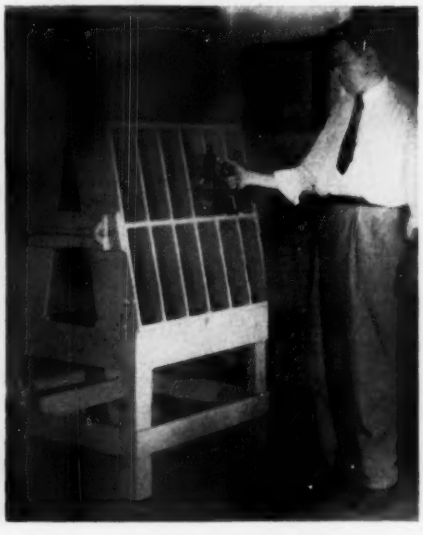
A set of tools—saw, hammer, pliers, wire cutters, shears, soldering iron, etc.—should be as much a part of the supplies of the department as the materials used in teaching. It is useful to set aside a space to place equipment which is in need of repair. This will, together with available hand tools, enable simple repairs to be made more readily. It will also serve as a constant reminder to get the repairs made or to send equipment to shops or factories for repair.

TEACHERS of the Biological Sciences should not overlook the need for sufficient homemade and purchased collecting equipment.[1] A great deal of the effectiveness of the department is often lost in not having on hand live material easily obtained in the local community. Also a teacher should not overlook the advantage of labeling a set of shelves as a "Museum" and building up a collection of specimens to develop interest in the department. Such specimens also are useful teaching aids. A set of cabinets (which can be homemade or purchased readymade) with compartments of the proper size to receive standard plant specimen sheets can serve as a herbarium. This can be built up over a period of years and can be equally useful as the museum.

Several kinds of cabinets for storing microscope slides can be obtained from supply houses. These are useful; however, regular wooden slide boxes can be arranged on shelves and catalogued as illustrated in Figure 1. The boxes need not be full to allow for additional slides and can be numbered in pencil to correspond to the permanent numbers on the shelf. This also allows for expansion, and makes it easy to locate and return a given group of slides. Incidentally, each slide in the box should also have the box and shelf number.

One of the major problems of the biology teacher is the convenient storage of preserved materials for class use. One successful way of doing this is to store them in large crocks

Fig. 3. This case mounted on wheels is used for transporting microscopes from room to room.



1—See Miller and Blaydes: *Methods and Materials for Teaching Biological Science*, McGraw-Hill Book Company, for many useful suggestions.

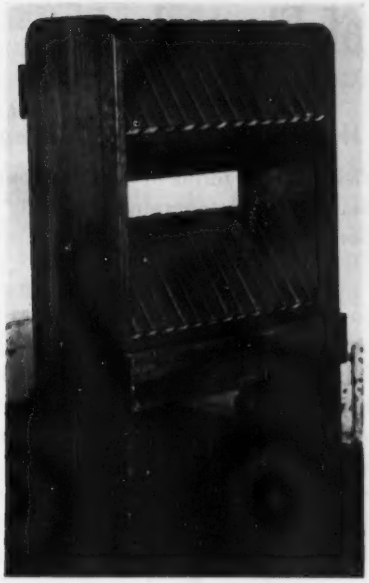


Fig. 4. Portable bookshelves make reference books accessible to students in each room.

and place them on a movable platform such as illustrated in Figure 2. The platform floor is made of 1¼"x2" strips spaced 2" apart. This makes it easier to keep the platform clean. Two shelves built up from the center of the platform are useful for storing small jars of materials and dissecting pans. After the specimens have been thoroughly preserved in formaldehyde, they may be successfully kept for fairly long periods of time in a supersaturated solution of borax in water.

FOR EASILY transporting microscopes from room to room a unit such as illustrated in Figure 3 can be constructed. This case is mounted on large rubber rollers and will hold 24 microscopes. The bottom of each space for the microscope is square with the edge of the case, but each side is tilted toward the center. This prevents the microscopes from bouncing out in transit and yet makes them easily accessible.

One or more sets of reference books are needed by each science department. Portable book shelves such as those illustrated in Figure 4 can be constructed and are useful in moving the books from room to room. Since they can be constructed so that a given number of books will just fit the shelves, the teacher can easily tell how many books are missing from the set after they have been turned in without having to count all the books.

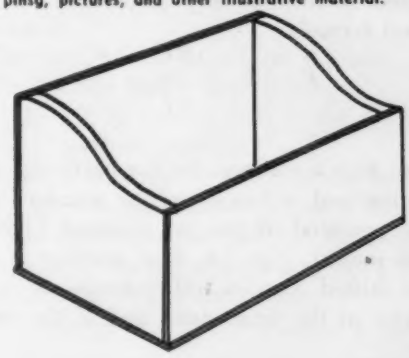
Around almost any science department, clippings, pictures, and other illustrative material are usually found. The accumulation of such teaching materials should be encouraged; however, by all means set up a system for filing these materials so they can be easily found and used by the teachers. Regular filing cases are desirable; however, if they are not available, simple box-files, as illustrated in Figure 5, can easily be constructed from apple boxes.

EVERY department has the usual amount of records and data to keep. Work out a series of these forms; cut stencils to mimeograph them; and then file the stencils. Forms for tentative schedules, enrollment data, fees collected, reports to the principal, superintendent, auditors, etc., departmental registration cards for students, teacher information blanks, textbook records, and many others to fit a given local situation can be made which will systematize the red tape in the department.

It is obvious, of course, that a larger department with more teachers and more rooms will require more organization for the getting, maintaining, and using of materials and equipment than will a small department. The suggestions given above will perhaps be more useful in a fairly large department. However, some organization of the department's physical assets is necessary regardless of the size of the department. Without such organization, it is so much easier for the teacher to rely on the text alone, because it is always convenient.

Continued on Page 143

Fig. 5. A box file can be used for storage of clippings, pictures, and other illustrative material.



Modernized Teaching of Electrolysis

C. W. BENNETT
Western Illinois State College

OCCASIONALLY one will hear a teacher say that an outmoded theory is easier for a student to understand even if it is wrong. There is no justification for such an imposition upon the student. On the subject of electrolysis many textbooks and teachers still fall into error. The complete ionization of strong electrolytes has been so well established for so long and our knowledge of standard electrode potentials so advanced that it is hard to understand why anyone would insist on using explanations which are outmoded.

In an *electrolytic cell*, the electric current, as a source of energy, produces chemical changes which are contrary to the normal tendencies of the substances involved, while in a *voltaic cell* the reactants in a normally spontaneous reaction are so separated that the electrons which would usually go directly from one atom to another must pass over a conductor, thus furnishing a source of electrical energy.

The electromotive force or the voltage which a cell produces (in the case of an electrolytic cell it has a negative value) may be measured accurately and may be thought of as the sum of the various potential differences existing in the cell wherever there is a junction of two different phases. It is customary, however, to neglect all but those between the electrodes and their solutions, the others actually being included in these values. The total EMF for the cell may be considered as the sum of the two single electrode potentials. The single electrode potential E is a definite value depending upon the concentration, temperature, and the nature of the ions and may be expressed mathematically according to the Nernst formula:

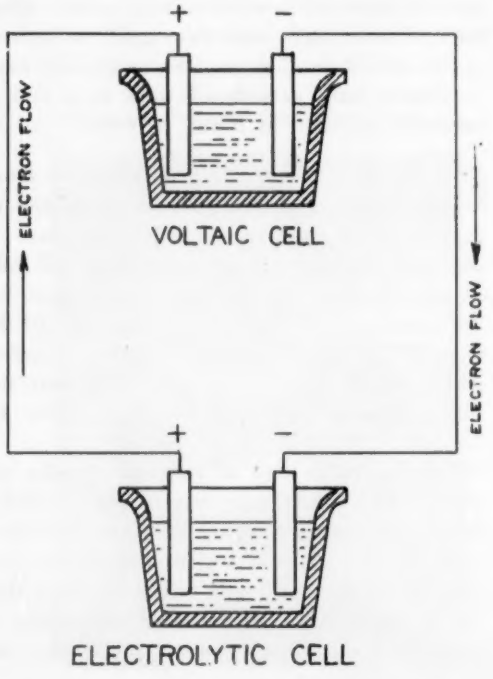
$$E = E_0 - \frac{RT}{NF} \ln \frac{a''}{a'}$$

where E_0 is a constant for the particular combination and is known as the standard electrode potential, R the gas constant (1.985 x 4.184 joules), $T = {}^\circ A$, N = number of electrons shifted, $F = 96{,}500$ coulombs, a'' = the activity of the final state, and a' the initial state.

Revising this in terms of common logarithms and assuming a temperature of 298° A. the equation becomes

$$E = E_0 - \frac{0.05915}{N} \log \frac{a''}{a'}$$

IF ONE of the states is solid or if it is a gas with a pressure of one atmosphere the a becomes unity and may be dropped from the expression. Also if the solution has such a concentration as to have an a of unity the whole expression $\frac{0.05915}{N} \log \frac{a''}{a'}$ becomes zero if the other state has a = unity, i. e. metal, etc., since $\log 1 = 0$. Then E becomes equal to E_0. While it is easy to determine the total EMF of a cell (consisting of two single electrodes), it is impossible to determine the absolute value of any one electrode. It is therefore customary to assign an arbitrary value for one electrode and calculate the others by reference.



Chemists have agreed to assign the value zero to E_0 for the system Pt, H_2, H^+ (interpreted as a spongy platinum electrode in contact with H_2 gas immersed in an acid solution of $a = 1$ where the H_2 gas is changing to H^+. Such an electrode is perfectly reversible and hence E_0 for the system H^+, H_2, Pt (interpreted to mean H^+ ions are changing into H_2 gas) is also zero. This half cell could be put with another half cell such as the system Zn. Zn^{++} so that we would have a zinc strip in contact with $ZnSO_4$ and a spongy platinum electrode in contact with sulfuric acid, both of them at unit activity. When the two electrodes are connected, the voltage can be accurately measured under specified conditions and is +0.76 volt. Since the hydrogen half cell is arbitrarily given the value of 0.00, the zinc half cell gets a value of +0.76 volts, the total EMF being the sum of the two single electrode potentials. In a similar way all possible combinations can be worked out to give standard electrode potentials. A negative or low value means that the reaction is difficult, and a positive or high voltage means it is easy. The total EMF of a cell with unit activities can be calculated by adding the standard electrode potentials, making sure that the signs are correct for the reaction as it occurs at the electrode. For a reversed reaction the sign must be changed. Thus, for zinc metal becoming Zn^{++} (Zn, Zn^{++}) $E_0 = 0.76$ but for Zn^{++} becoming zinc metal (Zn^{++}, Zn) $E_0 = -0.76$, indicating that the former is easy and the latter difficult to accomplish. Some *physicists*, however, use a different set of mutually consistent values.

I. Ions in Order of Increasing Ease of Discharge (1)

Cations

$K^+ + e \rightarrow K$	-2.92
$Ba^{++} + 2e \rightarrow Ba$	-2.90
$Ca^{++} + 2e \rightarrow Ca$	-2.76
$Na^+ + e \rightarrow Na$	-2.71
$Mg^{++} + 2e \rightarrow Mg$	-1.87
$Al^{+++} + 3e \rightarrow Al$	-1.67
$Zn^{++} + 2e \rightarrow Zn$	-0.76
$Fe^{++} + 2e \rightarrow Fe$	-0.44
$Pb^{++} + 2e \rightarrow Pb$	-0.12
$Fe^{+++} + 3e \rightarrow Fe$	-0.04
$2H^+ + 2e \rightarrow H_2$	0.00
$Cu^{++} + 2e \rightarrow Cu$	+0.34
$Ag^+ + e \rightarrow Ag$	+0.80
$Hg^{++} + 2e \rightarrow Hg$	+0.85
$Au^{+++} + 3e \rightarrow Au$	+1.42

Anions

$2F^- \rightarrow F_2 + 2e$		-2.85
PO_4^{---}, NO_3^-, SO_4^{--}, ClO_4^-	Very difficult, estimated at -2.0	
$2Cl^- \rightarrow Cl_2 + 2e$	-1.36	
$2Br^- \rightarrow Br_2 + 2e$	-1.07	-1.06
$2OH^- \rightarrow \frac{1}{2} O_2 + H_2O + 2e$	-0.40	(1M)
$S^{--} \rightarrow S + 2e$	+0.51	
$Se^{--} \rightarrow Se + 2e$	+0.78	
$Te^{--} \rightarrow Te + 2e$	+0.92	

AS WILL be seen from the Nernst formula, given above, there are other factors which must be taken into consideration besides the E_0 or standard electrode potential, the most important of which is concentration. Overvoltage, current density, and polarization are other factors which complicate the prediction of the behavior of a system during electrolysis but for the sake of brevity, they will be omitted here. (2)

In general, a low concentration for an ion being discharged would decrease the value of a' in the Nernst equation and hence lower the E for that reaction resulting in the need for the application of more energy to accomplish the discharge of the ion (A lower value of E means a more difficult reaction.) Before discussing the application of the standard potential table, let us examine some erroneous statements commonly found:

Erroneous

1. When a salt dissolves in water it becomes ionized.
2. The electric current ionizes the salt.
3. The current makes the ions move.
4. If the salt is ionized even in the dry solid state, it should conduct.
5. When a solution of KNO_3 is electrolyzed, K^+ goes to the cathode where it forms K metal which can not exist in the presence of water. K therefore reacts with water to liberate H_2 gas and KOH.

$K^+ + e \rightarrow K^0$

Continued on Page 136

1—Abridged from *Oxidation Potentials*, Latimer, p. 293, Prentice Hall, 1938, N. Y.

2—See the author's article, J. Chem. Educ. *13*, 516 (1936).

Science for Society

EDITED BY JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Teaching the Alcohol Problem

Alcohol Teaching Chaotic

OF THE TWO or three topics for which specific requirements are written into the laws of all of our states, the teaching of alcohol problems receives the most detailed and elaborate attention. One might presume, then, that this represents a major social problem, if one is to judge from such a cursory observation. (Actually, it is the result, directly and indirectly, of certain pressure groups). Yet, the teaching of alcohol problems is in a chaotic state. On the latter statement, there would be practically universal agreement. But, on the question of what constitute the reasons for confusion, there are points of view, faction prejudices, and pressure groups who would disagree widely.

In large measure, conflicting ideas have grown rampant for lack of scientific data. The United States Government has spent large sums of money in the futile attempt to enforce the ill-fated prohibition amendment to the Constitution. Millions more were spent for repeal. Yet, and in spite of this failure, our government, to this day, has made no appropriation for scientific investigation and research in the problems of alcohol.

Science Texts Unscientific

IN MOST instances, apparently, teachers are guided largely by their own preconceived notions. Publishers of textbooks in general science and in biology, for over a decade, have been incorporating into these texts discussions on effects of alcohol. Otherwise, no doubt, they would antagonize prohibition and temperance people. But, unfortunately, these science textbooks are notorious either in treating the subject inadequately or in giving credence to ideas that have either never been verified or have actually been proven false.

A common error is to describe conditions associated with alcoholism, albeit often incorrectly, and imply that such comments apply to the casual drinker. They ascribe certain diseases to the drinking of alcoholic liquors, but do not explain that it is nutritional deficiency, which often accompanies excessive drinking, that is the direct cause of these physical and mental diseases. In describing immediate physiological effects or eventual effects on bodily tissues, reference is practically never made to the quantity of alcohol imbibed or to individual variations in susceptibility. Many texts erroneously state that ingested alcohol destroys bodily tissues and damages cells by removing water, and that alcohol is habit forming. Some may still be found that ascribe ailments of the liver to the drinking of alcohol, and many suggest that drinking may affect heredity. Inebriety is given usually as a cause of emotional disturbance rather than as a result of the latter.

Social Aspects Neglected

WITH THE exception of traffic accidents, the social aspects of drinking are sadly neglected. There is practically no suggestion that drinking may have social value, for many people, under certain circumstances; nor that, under certain conditions, it may be useful in relieving tensions. Such an approach would invite appropriate discussions of problems of insecurity from which an occasional individual erroneously attempts to escape through excessive drinking. Problems of this nature should be met by appropriate social action aimed to eliminate major causes of insecurity. Among these are unemployment, substandard living conditions and racial prejudices. More attention should be given to education of the adolescent for wholesome emotional adjustment.

This is a positive approach, one to which

JOSEPH SINGERMAN
High School of Commerce
New York City

the young student can respond with interest and determination. The futility of the moral approach to temperance or abstinence have been amply demonstrated; increasing scientific knowledge leaves acceptance of that method only to the poorly informed. Just put yourself in the youngster's place for a moment. You observe drinking on the part of your elders and their friends. The movies, too, give it social prestige. You even see some bold individuals among your teenage acquaintances partake of some liquor. In school you are told about the evil effects and dire consequences of drinking. Are you to conclude that your elders are sinners, and wonder why they do not yet suffer from some of the evil consequences which you were assured will positively accompany the use of alcohol; or, will you decide that what they tell you in school is to be taken with a grain of salt? And, if that applies to the teaching of alcohol problems, it may very well apply to other aspects of your schooling. Maybe it is smart, too, to evade other laws when you have agreeable companionship?

Status of Alcohol Education

A few years ago, Anna Roe made a detailed study of the status of alcohol education. Her valuable report is embodied in a 132 page book entitled, *A Survey of Alcohol Education in Elementary and High Schools in the United States*. It is published by the Quarterly Journal of Studies on Alcohol.

Some states, Dr. Roe finds, in writing detailed requirements into their laws, actually specify the teaching of unscientific ideas. But, California, she notes, qualifies "effects" of alcohol with the phrase "as determined by science." This seems to be an outstanding exception, however. Eight states make specific mention of the Woman's Christian Temperance Union, whose representatives are invited to lecture in the schools. These workers, Dr. Roe finds also, are very active in additional states where no mention is made of them in responding to her queries. North Carolina sets aside the fourth Friday in January as Temperance or Law and Order Day, when schools are required to teach "scientific truths showing the evils of intemperance and lawlessness, set forth on placards, etc."

Dr. Roe ascribes the shortcomings of our textbooks to the obvious fact that the authors obtained their material in large part from publications of temperance organizations as well as to a lack of unbiased compilations of available scientific material.

Alcoholism a Sickness

ALCOHOLISM, as a sickness to which some people are or become susceptible, has received some enlightened consideration only recently. This established fact is unfortunately absent from our secondary school science texts. Almost without exception, they also make the inexcusable mistake of saying, or implying, "once an alcoholic always an alcoholic." A small percentage, estimated at 1.5%, of drinkers are potential alcoholics But there is no recognition that this is to some extent a social and economic problem for which there must be assumed a social responsibility. Physicians, in general, are notoriously not equipped with knowledge or inclination to treat the excessive drinker. Although chronic alcoholics outnumber active cases of tuberculosis, there is in this country, an almost total lack of free governmental institutions devoted to the proper study, care and treatment of the alcoholic. It is encouraging to note that Cornell University Medical College has initiated such a program, and that one is tentatively planned for the New York University College of Medicine in New York City. There are such centers too in the Langley Porter Clinic of the University of California in San Francisco, and one in the Los Angeles General Hospital of the University of Southern California. The organization of a clinic in Washington, D. C., was made possible only when a few physicians volunteered their services. The situation is in sharp contrast with systems of free government clinics maintained for some years in Sweden, Switzerland and the Soviet Union. In the latter country, which has gone through a social and economic revolution, the per capita consumption of vodka, in the years preceding the last war, fell to less than half that in 1913.

Continued on Page 140

Science Clubs at Work

Edited by MARGARET E. PATTERSON

Secretary, Science Clubs of America

• A department devoted to the recognition of the splendid work being done by science club members and their sponsors. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Miss Patterson, Science Clubs of America, 1719 N Street, N. W., Washington 6, D. C.

Science Club Members Profit From State and National Cooperation

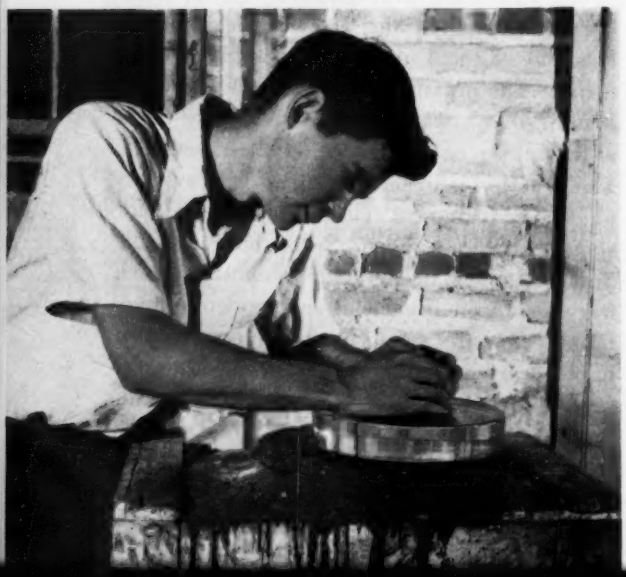
MARGARET E. PATTERSON

Science Clubs of America

ANY BOY or girl who wants a career in science today has a better chance of achieving it than ever before. This bright spot—in a world plagued with shortages due to lack of enough scientists and technicians—is due, in no small measure, to a cooperative arrangement between 38 science agencies in 33 states and the national organization, Science Clubs of America. The cooperative arrangement is giving boys and girls in science clubs a chance to learn about science and to get some early practice in it during their school years. It gives them opportunities to meet others of their own age with similar interests and presents occasions for getting acquainted with adult scientists. To those with talent, it provides assistance toward further education in science.

Cooperation between the national and state organizations is based on elimination of duplication of effort in serving science clubs.

This boy is grinding a mirror in his basement workshop. Courtsey of Science Service.



Functions of the National Organization

SCIENCE Clubs of America, a part of the national organization, Science Service, now has more than 14,000 affiliated clubs in every state and abroad. Its one-third of a million members are boys and girls ranging in age from 10 to 20.

No one expects all the members to be scientists. To some of them science is a passing fancy; to others it is an interesting hobby they will follow always. But to an elect group —and it is no longer small—science is a lifetime career. Members are apt to shift from one group to another. As they learn more about science and recognize its requirements, they may become more or less serious in following it. For this reason more than any other, the science club is the proving-ground of the scientists of tomorrow.

There is no charge for affiliation with Science Clubs of America, but each club must have an adult who will act as a sponsor. This person, most often a science teacher, is provided with fundamental literature for operating a successful club. Sponsors receive aids on how to organize a club and keep its program lively. Thousands of projects are recommended for individual club members and for the club to carry on as a group. Books in science are suggested for the club library, and the sponsor is introduced to sources of science material available free or at low cost from in-

Setting up an exhibit at a science fair is sometimes a family affair. Courtesy Science Service.

dustry. Each club is put in touch with agencies in its area that will be helpful.

SCIENCE Service, through Science Clubs of America, administers the annual Science Talent Search for the Westinghouse Science Scholarships. This competition gives the clubs' most talented members a chance for financial assistance in continuing their science education.

Functions of State Organizations

The 38 agencies in 33 states cooperating with Science Clubs of America include senior and junior academies of science, associations of science teachers, museums, newspapers and colleges. They are notified of clubs as they are formed and are assured that each is being serviced with general basic aids from national headquarters.

The cooperating agencies have programs as diversified as the areas they serve.

State Meetings for Science Clubs

ALL STATES make a major effort to provide chances for all clubs to meet together. These meetings, called by various means, give the stimulation that comes from seeing what other young scientists are doing. If the meeting coincides with senior meetings, the young people see adult scientists in action too, and may even be allowed to visit some of the sessions.

Many clubs pay expenses of delegates to meetings and urge others to attend at their own expense. Group rides arranged by willing parents cut costs and make larger delegations possible. Free or inexpensive lodging is often arranged by host colleges or host clubs in private homes or dormitories.

In areas where there are city-wide organizations, as at St. Louis, Rochester, N. Y., Pittsburgh, New York and New Orleans, the meetings can be spread out over the year at regular intervals. The New Orleans Junior Academy has guest speakers every month from college, university and professional sources, with one meeting for the showing of the members' work. Pittsburgh has a very large science congress during the Christmas holidays. Members from a wide surrounding area speak on their work in many different fields.

MOST STATE meetings honor those presenting the best work with awards such as cash, savings bonds and stamps, recognition before the adult meeting or honorary memberships in the senior organization.

Virginia has set up the E. C. L. Miller Award to be given each year to the club in the state showing the best record of accomplishment. This state also has awarded the best sponsors scholarship funds for use in summer sessions at any chool of the recipient's choice.

Communications to Science Clubs

Every state cooperating with Science Clubs of America has some method of communicating regularly with its clubs. All use form-letter communications. A few have access to the press, such as those using the *Pittsburgh Press* and the *Providence Journal*, where communications are part of regular news columns written for science clubs. Many states have bulletins or journals edited by adults or by members. A few states have both.

Wisconsin has the adult-edited *Newsletter*. It is sent out often and is designed for bulletin-board use so that members and sponsors have easy access to timely information. Once a month members receive *The Test Tube Times*. The editorship of this journal is circulated among clubs so that a different one is responsible for each issue. It may be printed, mimeographed with cartoons, mimeographed with pasted photographs or otherwise duplicated as suits the experience, age, budget, and facilities available to the member editors.

MOST elaborate of the state publications is the *Illinois Junior Academy of Science*

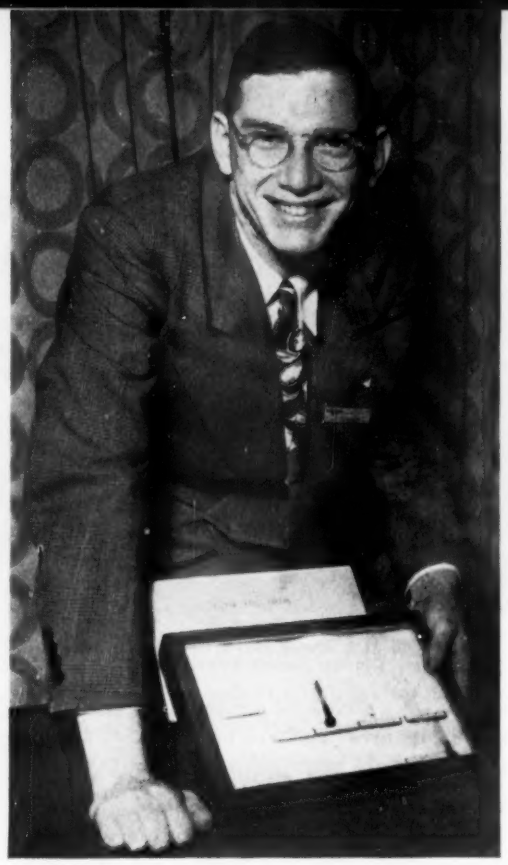
Yearbook, sponsored by the senior Academy of Sciences. It contains student-written and illustrated articles. It is financed by sustaining members listed by name on the last page of the *Yearbook*.

Georgia prepares releases pseecially for educational journals in the state and for newspapers. Virginia has outlets for stories about clubs in the newspapers of the state, in educational and civic journals and in the journal of the senior academy. Many states issue handbooks for members, giving the history, principles, program, and advantages of the organization. An interesting one of this kind is the *Wisconsin Club Directory* which gives the following data about each club: name, school, number of members by sex, day and time of meetings, interests of members, name of sponsor, and scheduled activities. This makes possible correspondence and visiting between clubs.

State Science Talent Searches

A FAIRLY recent development in state cooperation is the State Science Talent Search. In 1946 these were held in Virginia and Tennessee; in 1947 Georgia, Illinois. Iowa, Louisiana were added, and plans for 1948 are being made by other states to carry out state searches. A state science talent search is timed to run concurrently with the annual Science Talent Search for the Westinghouse Science Scholarships. All entrants in the national competition are automatically entered in the state competition.

Entry materials of all contestants from a state are scored to a certain point and are turned over to a judging committee within the state after the winners and honorable mentions in the national competition have been chosen. The state judging committee makes its choice of students who are worthy of scholarship or other financial assistance in colleges and universities within the state. In the states that have completed searches, from three to 40 high school seniors per year per state are assisted in this way.



Milton Paul Gordon of St. Paul, Minn., one of the winners in the 1947 Science Talent Search. He will use his $400 Westinghouse Science Scholarship at the University of Minnesota where he will study chemistry. Credit: Science Service. (1946)

There has been a very fine reception of this plan on the part of colleges and universities always on the watch for exceptional science students. In a number of cases, college precedents have been shattered in setting up scholarships especially for students found worthy through state searches. Judging committees are composed of scientists within the state who are skilled at recognizing ability among young scientists.

Some state science talent search winners have received outright awards of cash; others have received scholarships, and still others have been given recommendations that have resulted in scholarship assistance. In almost

Getting to know fellow-enthusiasts is the high point in any science fair. Credit: Science Service.

This group from Virginia is the first ever chosen as winners in a state science talent search. Credit: Colonial Studios—Richmond.

every case, the winners of state searches have been accorded an audience before adult scientists for their papers or demonstrations of their work and have also appeared as top speakers at state meetings of their fellow club members. They have been guests at banquets in their honor, and have taken trips specially planned for their pleasure.

Considerable state pride has been aroused by state searches and in all cases plans are being made to further publicity on the event in order to acquaint the public more thoroughly with this development. One state reports two grants of $1,000 each from industrial sources to enlarge this part of their program and another state has a budget of $9,500 from similar sources to start such a program.

Science Fairs

EXTENSIVE science fairs are being held by many cooperating states. All state and district meetings hold such exhibits and displays of members' work.

The most elaborate science fairs are those now being held in New York City, Pittsburgh, Providence, R. I., and Washington, D. C. All of these serve large areas and the one in Providence is open to science students in public, parochial, and private schools throughout the state.

Hundreds of young scientists of all ages show their work at these science fairs and compete against others of their own age range. Exhibits are arranged and judged according to subject area. The fairs are open to the public and attract thousands for their three to 10 days' duration. School gymnasiums and cafeterias, armories, museums, public building auditoriums and Madison Square Garden are the show places for these fairs. Awards range from ribbons to generous scholarships. Books, magazine subscriptions, certificates, medals, laboratory apparatus, credit slips, etc., are other awards given.

Lecture Service

Some states, like Georgia, have started a science lecture service. Each club sponsor receives a list of speakers who are willing to talk before clubs or club events. Subjects on which they will speak are indicated and any stipulations about time, distance, etc., are indicated. Club sponsors are then free to negotiate with speakers to make necessary arrangements.

Radio Broadcasts

A few states have access to radio facilities for short periods of time or during major events. Illinois has a set time each week especially for clubs, when adult speakers and sometimes members talk to the clubs of the state.

SCA COOPERATORS

ALABAMA

Alabama Academy of Science
Miss Kathryn M. Boehmer, SCA Cooperator.
(address) Head, Science Dept.
Ensley High School, Birmingham, 8

Alabama Assn. of Science Teachers
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(address) State Teachers College
Montgomery

ARKANSAS

Arkansas Academy of Science
Dr. I. A. Wills, SCA Cooperator
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John Brown University
Siloam Springs

DISTRICT OF COLUMBIA

Washington Science Fair Committee
Keith C. Johnson, Chairman
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Florida Junior Academy of Science
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GEORGIA

Georgia Academy of Science
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Principal, Statesboro High School
Statesboro

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Illinois Junior Academy of Science
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Decatur

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Indiana Junior Academy of Science
Dr. Howard H. Michaud, State Sponsor
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Department of Forestry
Purdue University, Lafayette

IOWA

Iowa Academy of Science
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Iowa State College, Ames

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Northwestern State College
Natchitoches

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Junior Academy Sponsor
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New Orleans 12

MAINE

Science Department
Maine Teachers Association
Maurice M. Whitten, Representative
(address) Science Department
Wilton Academy, Wilton

MARYLAND

Maryland Academy of Sciences
Allan C. Davis, President
(address) Enoch Pratt Free Library
Baltimore 1

MASSACHUSETTS

Children's Museum
Miss Miriam E. Dickey
Asst. in Education Department
(address) 60 Burroughs Street
Jamaica Plain 30

MICHIGAN

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Michigan State College
East Lansing

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Minnesota Junior Academy of Science
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St. Cloud

MISSISSIPPI

Mississippi Academy of Science
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Junior Academy Committee
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University of Mississippi
University P. O.

MISSOURI

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Montana State College
Dr. Adrien L. Hess
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Montana State College, Bozeman

NEW JERSEY

The Newark Museum
Miss Alice Kendall
Director
(address) 43 Washington Street
Newark 2

NEW YORK

Buffalo Museum of Science
Ellsworth Jaeger, Curator of Education
(address) Buffalo Museum of Science
Humboldt Park
Buffalo 11

The American Institute of the City of New York
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(address) 61 West 56th Street
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Hartwick College
Mrs. Madeline Frink Coutant
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Oneonta

Rochester Museum of Arts and Sciences
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Rochester 7

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University of North Carolina
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(address) 416 S. New Jersey Ave.
Wellston

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University of Oklahoma
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Johnstown Central High School
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The Press Science Clubs
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Pittsburgh 30

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Clemson Agricultural College,
Clemson

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Junior Academy Committee
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Ball High School, Galveston

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Dr. F. G. Lankford, Jr., Chairman
Science Clubs Comm. of V.A. of S.
(address) Dept. of Education
University of Virginia,
Charlottesville

WEST VIRGINIA

West Virginia Academy of Science
Dr. J. E. Judson, President
(address) Prof. of Biology
West Virginia Wesleyan University
Buckhannon

WISCONSIN

Wisconsin Junior Academy of Science
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(address) 209 Biology Bldg.
University of Wisconsin,
Madison 6

Adaptable Equipment for Use in General Science

LOUIS T. COX
State Teachers College
Towson, Maryland

I BECOME more convinced as time goes by that there are degrees of first handedness of science experiences. When the learner has to obtain an experience through use of equipment involving new concepts or attitudes or emotions toward the equipment itself, the science and social implications of the experience are not going to be as meaningful as the use of familiar materials could make them.

Do you remember your first experiences with test tubes, beakers, flasks, tuning forks, and ring stands? I know that they were very special pieces of equipment to me for a long time before I realized they are merely convenient, standardized jars, bottles, vibrating bodies, and holders, respectively. The use of these special pieces of laboratory equipment brings to the minds of many pupils romantic notions of mysterious chemical secrets, of Frankenstein, and of other sensational movie thrillers. This is not altogether undesirable, because we do want interest in general science, but not an undue amount of interest in strange apparatus.

Aside from these considerations, the boys and girls in general science may try some of your demonstrations or experiments at home if you use equipment that can be adapted from dad's work bench, the kitchen cabinet, the pantry, or the bathroom. Many of the materials that can be used are inexpensive items from the hardware, ten cent, music and art supply stores.

Below are described some experiences using these adaptable materials in the studies of sound, light, and energy.

I. Sound

MUSIC is a natural lead into the study of sound. This could be very boring to the boys and girls who play no instrument. So, the first job is to convince them that anyone can play some music on any musical instrument—and this is true of bugle calls. "Taps," "Reveille," and "Assembly" all use only four notes which can be found easily on any instrument. The following musical instruments usually are available in ten cent stores, music stores, or at home: toy xylophone, harmonica, guitar, toy flutes, and whistles.

With the toy xylophone, first find the Sol, Do, Mi, Sol or C, G, E, C for playing bugle calls and then note some of the relationships between vibrating bodies. That the pitch depends on the length of the bar is obvious. By measuring any two bars one octave apart, it is found that the higher pitched one is exactly ½ as long as the other to make it vibrate twice as fast. Note also that each bar is suspended at points ¼ of its length from each end. These points are the nodes around which the rest of the bar vibrates. Try removing a bar and holding at different points while tapping it.

THE harmonica is very good for showing some principles of vibrating reeds. The bugle calls are also easy because the four notes needed are four adjacent "blow" holes. By removing the cover plates and looking inside, or better, using the opaque projector to throw an image on a screen, the relationship between length of reed and pitch is clearly shown. On better instruments, tuning devices and air valves ("breath savers") will be seen.

Vibrating strings are the sound producers on many musical instruments that will be brought from home. The guitar is large and easily seen in demonstrations from the front of the room. Show that the pitch of any one string depends on the tension, and that with all strings at about the same tension the heavier strings vibrate at lower pitches. After showing that the frets are used to shorten the strings to obtain intermediate pitches, find the four notes on any one string to play bugle calls, or tune four of the strings to those four notes. Can you explain why the frets are spaced closer together near the sound box? Pressing any string to the 12th fret (half the length of the string) raises its pitch one octave. Some of the overtones of the string can be heard by touching the string lightly at ½, ⅓ or ¼ its length. Resonance is shown if two of the thick strings are tuned to the same pitch. Then when one is plucked, the other

Continued on Page 142

Audio-Visual Aids

EDITED BY CHARLES R. CRAKES

The editor of this department will attempt to bring before the readers of this publication the latest articles written by science teachers who are making effective use of various forms of audio-visual teaching materials. He will also endeavor to present a cross-section of educational opinions on audio-visual aids he may gather in travelling about North America.

Mr. D. F. Schutte's article "Visualizing the Science Curriculum" was started in the April issue, but due to lack of space only part of his very fine list could be printed. Mr. Schutte has developed a list of filmstrips which will be useful to Biological Science Classes. The list in the April issue closed with a filmstrip on Arthropods. For your convenience, we have republished "Film Rating" and have given you "Film Sources".

Your editor was well pleased with the response received to his invitations for articles to appear in this column. As a sufficient number has already been received to take care of the Journal for the current school year, may we suggest that you decide now to write an article for publication next year. Send it to the editor by March 1st, 1948.

In the December issue, we will have an article of interest to high school teachers by Mr. Robert Bullington, Department of Science, MacMurray College, Jacksonville. Illinois, entitled "Do You Use Audio-Visual Aids?" In the February issue, an article entitled "Audio-Visual Materials and the Elementary Science Program" by Miss Marguerite Albrecht, Principal, Irving School, Moline, Illinois. In the April issue, will appear another article of interest to high school science teachers entitled "Audio - Visual Aids and Physics" by Mr. Harold B. McCreight, Science Instructor, Union High School, Visala, California.—C. R. Crakes, Editor.

Visualing the Science Curriculum

D. F. SCHUTTE

Director of Visual Education
Public Schools, Red Wing, Minn.

Concluded from February Issue

FILM SOURCES

1. Society for Visual Education
   100 East Ohio St., Chicago, Illinois
2. Dewey & Dewey
   Kenosha, Wisconsin
3. Stilfilm, Inc.
   8443 Melrose Avenue,
   Hollywood 46, California
4. Castle Films, Inc.
   30 Rockefeller Plaza New York 20,
   NeW York
5. Metropolitan Life Insurance Company
   New York City
6. Coronet Films
   919 North Michigan Avenue
   Chicago 11, Illinois
7. General Electric Company
   Publicity Dept.,
   Schenectady, New York
8. Eye Gate House, Inc.
   New York City
9. American Council on Education
   Washington, D. C.
10. United Airlines
    5959 South Cicero Avenue,
    Chicago, Illinois
11. Visual Sciences
    Suffern, New York
12. Jam Handy
    230 North Michigan Avenue,
    Chicago, Illinois
13. Radio Corporation of America
    Camden, New Jersey

FILM RATING:

A—Very good
B—Good
C—Satisfactory
D—Fair

E—Poor

Ratings follow the listings of the titles of the filmstrips.

Manual:

M—Follows all titles that are accompanied by study guides.

Color:

K—Follows all titles that are in color.

Script:

S—Follows all titles that have a script or printed explanation on the film.

Animals

Insects & Growth and Structure 2-A-S
Frogs, Toads & Salamanders 1-B-S
Spiders 1-B-S
Birds of Orchard and Woodland 1-C
Desert Animals 1-B-S
Wildlife in Africa 1-C-S
Simple forms of Life 2-A-M-S
Birds 2-C-M
Story of Sponges 1-B-S
Story of Oysters 1-B-S
Tree Toad 1-B-S
Nesting Birds 1-C-S
How Animals are Protected from Enemies 1-B-S
How Young Birds Get Food 1-B-S
Soil Conservation & Wildlife 2-B-M-S
Insect Pests of Garden Vegetables & Their Control 2-A-S
The Anatomy of the Honey Bee 2-A-S
Grasshoppers & Their Control 2-B-S

Birds

Birds of Orchard and Woodland 1-C
Birds 2-C-M
Nesting Birds 1-B-S
How Young Birds Get Food 1-B-S

Conservation

Soil Conservation 9-C-M
Irrigation 9-C-M
Panorama of the U. S. 9-C-M
National Parks 9-C-M
Fire Extinguishers 4-B-S
Forests of the U. S. 9-C-M

Environment

Primitive tools 1-D-S
Soil Conservation 9-C-M
Panarama of the United States 9-B-M
Coast to Coast Geograph From the Air 10-B-M-F-S
Weathering and Wind Deposits 1-D-M
Geology of Caves 1-E-M
Simple Forms of Life 2-A-M-S
How Animals are Protected from Their Enemies 1-A-S
Icebergs and Glaciers 1- D-M
Soil Conservation and Wildlife 2-A-M-S
Soil Erosion in the U. S. 2-A-S

Food

How to Cook Meat 1-C-M-K-S
Foods and Digestion 2-C-M
Nutrition 9-C-M
Gardening Cartoons 2-A-S
Backyard Garden 2-C-M-S
Insect Pests of Garden Vegetables & their Control 2-A-S
History of Agricultureal Implements 2-B-M-S
How to Bake Bread 2-C-S-F

Forests

Forests of U. S. 9-C-M
Forest Fires 2-C-M
Paper in the Making 1-A-M-S
Famous Trees of U. S. 2-D-M
Forests & Human Welfare 2-C
Propagation of Trees & Shrubs 2-A-S

Health

How to Live Long 1-A-S
Nutrition 9-C-M
How Plants and Animals Cause Disease 2-A-S
Temperature, Respiration and Blood Pressure 444-D-S
Dental Health for the School Child 1-A-M-F-S
How to Prevent Disease 2-A-M-S
Firts Aid 2-C-M-S
Louis Pastuer 5-B-F-S
Edward Jenner 5-B-F-S
Robert Koch 5-B-F-S
Walter Reed 5-B-F-S
Madame Curie 5-B-F-S
Edward Livingston Trudeau 5-C-F-S
Florence Nightingale 5-B-F-S
Elementary Physiology 2-A-M-S

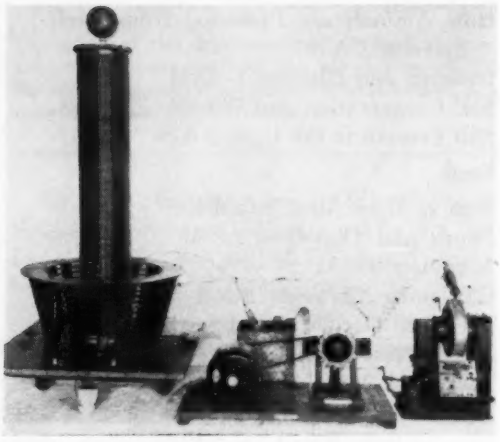
Insects

Monarch Butterfly 1-A-S
Arthropods 11-B-S
Vegetable Garden Insect Control 2-A-M-S
Insects, Their Growth & Structure 2-A-S
The Anatomy of the Honey Bee 2-A-S
Some Spiders & How They Live 1-B-S
Grasshoppers & Their Control 2-B-S

Continued on Page 143

"High Tension" Electricity

DAVID G. VEQUIST
Benton High School
Saint Joseph, Missouri



This Tesla coil when tuned will produce a spark up to nine inches in length.

NEARLY everyone is intensely interested in apparatus for the demonstration of high voltage electricity. For the science club, school assemblies, or the adult group the Tesla Coil here illustrated will create interest and discussion.

The apparatus, with the exception of a one-kilowatt transformer of the type used in the early stages of wireless telegraphy, can easily be built by the students. When adjusted and tuned it will produce a fat spark up to nine inches in length. The potential will be in the order of several hundred thousand volts, but because of its high frequency the electricity can be conducted harmlessly over the body to light ordinary flourescent lamps. To avoid burns, contact should be made through a piece of metal which is held in the hand. Care should be used so that the eyes are not struck by the discharge.

The number of tricks that can be carried out will depend on the ingenuity of the performer. The author has used the apparatus to present serious topics to a wide variety of audiences. In all instances of the use of this Tesla Coil the teacher should be in charge because of the danger involved in the 25,000 volt 60 cycle portion of the circuit.

REFERENCE to the drawing will provide most of the details for construction. Ad-

Diagram showing plan for constructing a Tesla coil.

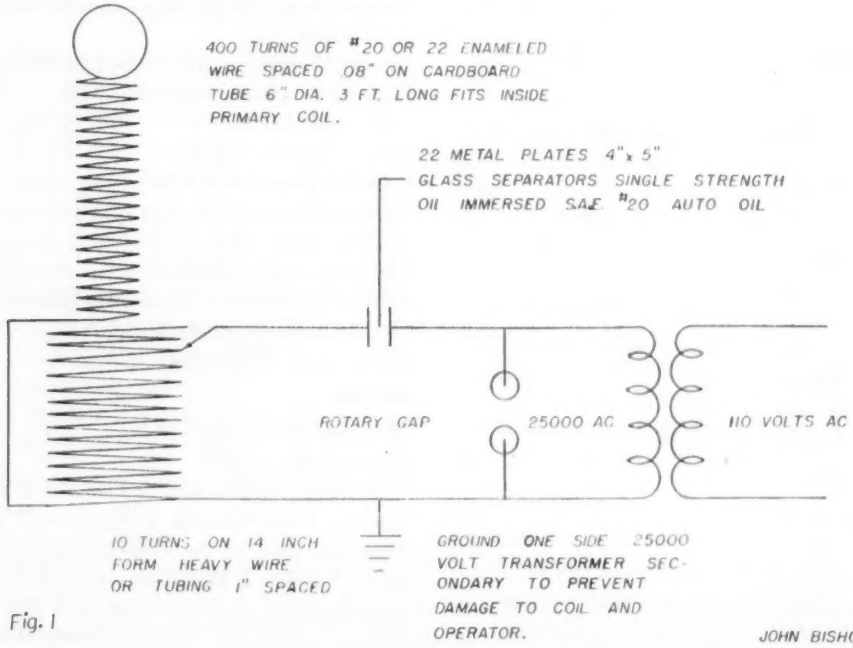

400 TURNS OF #20 OR 22 ENAMELED WIRE SPACED .08" ON CARDBOARD TUBE 6" DIA. 3 FT. LONG FITS INSIDE PRIMARY COIL.
22 METAL PLATES 4"x 5" GLASS SEPARATORS SINGLE STRENGTH OIL IMMERSED SAE #20 AUTO OIL
ROTARY GAP
25000 AC
110 VOLTS AC
10 TURNS ON 14 INCH FORM HEAVY WIRE OR TUBING 1" SPACED
GROUND ONE SIDE 25000 VOLT TRANSFORMER SECONDARY TO PREVENT DAMAGE TO COIL AND OPERATOR.

Fig. 1

JOHN BISHOP

justment and tuning involves moving the clip connector of the wire from the condenser up or down on the turns of the primary of the Tesla Coil. If the tuning is difficult remove or add plates to the condenser. Mica may be used instead of glass to increase the capacity of the condenser. The rotary gap can be cut from a circular plate of metal 7 or 8 inches in diameter with teeth on the edge about one inch apart. A motor driven grinder arbor may be used to rotate the plate between terminals which are attached to the secondary of the 25,000 volt transformer. The teeth should pass as close as possible to the terminals without touching. The secondary of the Tesla Coil should be shellacked.

Similar apparatus can be constructed on a smaller scale using a lower voltage transformer and less power, but of course it will not be as spectacular. Most books giving information on the Oudin and Tesla Coils are out of print, but construction data appeared recently in a popular magazine.[1] The coil described in the article mentioned above has been used in theatres and as a movie "prop"; and it is claimed that it will produce a spark twelve inches in length and will produce a corona that will literally make one's hair stand on end.

1—Tracy Diers, "Cigar Box Tesla Coil," *Popular Science Monthly*, Student Supplement, Vol. 148, No. 1 (January, 1946). See also K. M. Swezay, "Simplified Tesla Coil," *Popular Science Monthly*, Vol. 125 (December, 1934), p. 65; and G. K. Pierce and H. D. Campbell, "Complete Plans for Building a Tesla Coil," *Industrial Arts Magazine*, Vol. 18, No. 3 (March, 1929), p. 100.

NATURAL RESOURCES PLANNING

Continued from Page 113

will guide the revision of the manuscripts; they will see to it that the right persons are invited to a conference and that these persons receive the manuscripts with instructions that they study these materials and come to the conference with specific criticisms — interlinear, supplementary and/or deletions. The conference itself must be planned in full detail so that the needs of the conferees will be met. The general session must be so set up that the importance of the theme will be accepted by the conferees. There will be opportunities for questions and comments. Then there will be sessions at which the manuscripts will be openly criticized. Following such sessions the conference will divide into groups for serious work on the manuscripts including very careful consideration of how the problems can be solved in practice. After such work sessions the results will be reported to the entire group. It is after the conferees return home that the major work begins and again stimulation and guidance should continue to emanate from some person or persons so that the "pot may be kept boiling". The "pot may be kept boiling" by work-conferences on a regional, state or community basis. Then there are other procedures of major importance to be given serious consideration such as: workshops, resource-use development, and on-the-job experience.

You will hear several reports about workshops this afternoon. Like work-conferences the values of workshops will be determined very largely by the pre-planning which has been done in advance of the opening session. Such pre-planning will be concerned with (a) the amount of time to be made available, (b) the persons who will be included as participants in the workshop, (c) the training and experience of the selected staff members, (d) the materials and experiences to be made available to the participants, (e) the nature of the problems to be pursued, (f) the kinds of reports which are envisioned and (g) the distribution and publicity planned for the results. In my judgment, less than three weeks of full-time participation can be of but little help; a non-representative group will result in rather narrowly adapted suggestions; staff members who have not had recent and extensive contact with pupils like those the teachers are regularly serving are likely to encourage proposals that are poorly suited to the needs of the teachers and the pupils; reports that seem very good to the authorities are often devoid of the helpful details that will recommend them to teachers; and even a good report will be of but limited service until and unless some very substantial channels for publicity and distribution are used. Workshops require much pre-planning, realistic guidance, money to attract the right persons as participants, competent and real-

istic consultants, extensive library facilities, opportunities for actual studies of projects in the community, carefully organized and directly helpful reports, and vigorous follow-ups.

THE DEVELOPMENT of resource units or resource-use units also offers a very great possibility of increasing natural resources planning and conservation education. The greatest possibility is offered when these units are planned for teachers and other leaders as we now find them in our schools. The regular responsibilities of these persons should be carefully considered so that the suggestions will enable them to do something which they are expected to do and to do it easily. Here our would-be reformers make their great mistake in that they wish for and try by one glorious job to get the needed changes made. We must realize that great changes come through many small changes and we should feel happy as long as teachers and other leaders are making real and noticeable progress in the proper directions. Suggesting and expecting too great changes will result in a resource unit that will not be used. A realistic resource unit with many proposals clearly described in terms of teacher and pupil activities, is what should be developed. This means that for the most part you and I cannot prepare such resource units because we cannot be realistic, simple, and practical enough. We need to secure the help of ordinary teachers and ordinary leaders so that useful suggestions for the great number of ordinary persons may emerge. We need to set up a procedure premised on 5 to 10 years of progressive work so that a great change may come as a result of many lesser changes. No one-shot effort will bring resource-use and conservation into the schools to an adequate degree. Ten billion little dams produced by a mat of vegetation growing on a slope is far more effective than one big dam somewhere in the valley.

The next area of suggestions which I desire to discuss is on-the-job experience. This can be combined with workshops, but much more extensive participation is to be desired. I would like to suggest that some classroom teachers should be employed full summers, full terms, or full years on real conservation jobs *and after such work return to teaching.* If such employment can be combined with studies in related fields at a near-by college under the immediate direction of a person who really understands the theory and practice involved, it would be a very enriching experience and the teacher would bring into his classroom the background which makes possible vivid enough examples of theory and "know-how" that pupils will learn what really can be done about conservation and resource use. I realize that on-the-job training may appear to be somewhat expensive in terms of the work that the inexperienced teacher can perform for the compensation received, but we must consider the cumulative affects of such experience and instruction. We must consider the idea that the teachers will be working with greatly increased effectiveness during each school year following such on-the-job employment. They will also be able to participate constructively in resource-unit development and in work-conferences. I am urging that State Conservation Departments and Federal Conservation Laboratories should actually employ classroom teachers for work on actual projects. I am urging that even when they find a truly superior person that they will not continue to employ such persons —until these persons have returned to teaching and added their contribution to teaching practice.

THERE REMAINS for me to point out the implications of these procedures for resource use and conservation education as these concern the physical sciences. Some physical and chemical themes for work conferences, workshops, resource-use development, and on-the-job experience which are rather directly related to the physical sciences are those concerned with energy and materials. Some examples may be: Fuels for Tomorrow, New Metals for New Uses, Developments in Chemurgy, Water Control, Safety from Fire, Highway Maintenance, Soil Testing and Fertilizing, Machine Maintenance, Pollution Control, Sewage Disposal, Insulation, and Soil Erosion. Even such titles as: Aviation, Metric System, and Electronics, might be given strong conservation and resource-use emphases.

I have stated that much pre-planning is re-

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quired for the development of such materials and that lets me out when it comes to giving details. However, let me now indicate some sources of help that I consider apropo to these themes:

1. A Curriculm Guide to Fire Safety, Bulletin 1946, No. 8. Federal Security Agency, U. S. Office of Education.
2. An outline for Teaching Conservation in High Schools. U. S. D. A. Soil Conservation Service.
3. Education in Conservation of Soil and Water, Report of the Northern Great Plains Conservation Education Committee, 1945, State Education Dept., Lincoln, Nebraska.
4. Determination of Water Quality. U.S. Department of the Interior, Fish and Wildlife Service, 1946.
5. Available Publications of the Soil Conservation Service, August 1946.
6. Materials of Interest to Teachers. Forest Service U. S. D. A.
7. Bibliography, Available Literature on Conservation for Schools. U. S. D. A. Soil Conservation Service.
8. Water and Our Forests, Miscellaneous Publication No. 600, U. S. D. A. Forest Service.
9. Government Printing Office, Price Lists:
   - No. 18 Engineering and Surveying
   - No. 20 The Public Domain
   - No. 21 Fish and Wildlife
   - No. 31 U. S. Office of Education
   - No. 42 Irrigation, Drainage, and Water Power
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   - No. 51 Health
   - No. 53 Maps

TEACHING OF ELECTROLYSIS

Continued from Page 121

$2K^{\circ} + 2HOH \rightarrow 2KOH + H_2$

The NO_3^- goes to the anode where it forms NO_3 radicals,

$NO_3^- \rightarrow NO_3^{\circ} + e$

but these radicals cannot exist in the presence of water which they attack to form O_2 and HNO_3.

$2NO_3^- + H_2O \rightarrow 2HNO_3 + \frac{1}{2}O_2$

This is proved by liberation of H_2 at cathode, O_2 at the anode, and the facts that the cathode region becomes alkaline and the anode region acid.

6. When a solution of NaCl is electrolyzed the Na^+ ions go to the cathode where they are discharged to Na metal which cannot exist in the presence of water.

   $Na^+ + e \rightarrow Na^{\circ}$

   The Na, therefore, reacts with the water to liberate H_2 and NaOH.

   $2Na^{\circ} + 2HOH \rightarrow 2NaOH + H_2$

   The Cl^- ions go to the anode where they are discharged to form Cl_2.

   $2Cl^- \rightarrow Cl_2 + 2e$.

Corrected

1. A salt is always ionized even in the solid state. Water merely separates, mobilizes, and insulates the ions.
2. The salt is already and always was ionized prior to electrolysis.
3. The ions in a molten or dissolved salt are already in haphazard motion. The current directs the motion toward the pole of opposite charge.
4. The current in the case of a non-metallic conductor is carried by ions. Ions do not conduct in the solid state which by definition is rigid.
5. A solution of $K^+NO_3^-$ contains large numbers of K^+ and NO_3^- along with a much smaller amount of H^+ (no doubt as H_3O^+) and OH^- from the water. The electric current attracts K^+ and H^+ to the cathode and NO_3^- and OH^- to the anode. At the cathode there is a choice between K^+ which is very difficult to discharge and H^+ ions which are easily discharged but relatively rare. The H^+ ions are, however, derived from an almost unlimited reservoir—water molecules. The H^+ ions are then discharged to form H_2 gas. The water in the cathode region is therefore depleted of H^+, OH^- ions are left, hence it is alkaline. In like manner, at the anode the choice is between NO_3^- and OH^-. The latter is much more easily discharged than NO_3^-, hence they change to O_2 and H_2O. This depletion of OH^- leaves a regional excess of H^+ making an acid solution. If the contents were stirred, the H^+ and OH^- would neutralize each other and only a solution of $K^+NO_3^-$ would be left.
6. A solution of Na^+Cl^- contains large numbers of Na^+ and Cl^- and much smaller amounts of H^+ and OH^- from the water. The cathode attracts the Na^+ and the H^+ while the anode attracts the Cl^- and OH^- ions. At the cathode the liberation of Na^+ ions will require 2.71 volts more than the H^+ ions, which are not so abundant but as they are discharged more water dissociates so that there actually is an inexhaustible supply of H^+. The discharge of H^+ results in the increase of OH^- ions around the cathode.

   At the anode the discharge of Cl^- will require 0.96 volt more than that of OH^- at the same concentration, but the small number of OH^- ions (i. e. 10^{-7}) decreases their chance of being discharged except in very dilute solutions. (A M/32 solution of NaCl does evolve some O_2 at the anode. More concentrated solutions evolve more Cl_2 and less O_2).

   The ions of Na^+ and OH^- will therefore be left in solution. This explains a well-known commercial method of preparing NaOH, Cl_2, and H_2.

IN AN electrolytic cell the negative pole is the cathode, which attracts cations (the positive ions) since it has an excess of electrons. These electrons have traveled through the external circuit from the anode which is positive since electrons are being withdrawn there. In a voltaic cell it is better not to use the terms "cathode" and "anode", but simply to say "positive" and "negative" poles. Here, however, the electron flow is from negative to positive in the external circuit. Thus one needs to make a careful distinction between the two kinds of cells in saying what happens at an electrode. The drawing shows that the two

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positive poles are connected directly when both cells are used in series:

In an electrolytic cell the total EMF will usually be negative or have a low absolute value, showing that electrical energy is being changed to chemical energy hidden in the products of the cell. The total EMF of a voltaic cell is a high absolute value, showing that electrical energy is being given off from the chemical energy stored in the materials of the cell.

THE SOLUTION in an electrolytic cell will not decompose without the application of electrical energy. The products are liberated separately at the cathode and anode, but if brought together they are usually capable of spontaneous reunion. For example, the electrolysis of water produces H_2 and O_2 gas. Water does not normally decompose, but is forced to do so by the electric energy which is put into the cell. This energy now appears as chemical energy in the H_2 and O_2. These elements are much more active than water and if united explode and release their energy as heat and light.

The materials from which a voltaic cell is constructed possess chemical energy which ordinarily would be lost as heat if the two important parts were in direct contact. The interposed solution and conductor force the electrons to travel far enough so the electrical energy can be used.

The Daniell cell illustrates this principle. If a piece of zinc metal is put into a copper salt solution, the zinc replaces the Cu^{++} ion thus: $Zn + Cu^{++} \rightarrow Cu + Zn^{++}$
Actually electrons are transferred from the Zn to the Cu^{++}. When they are in direct contact the movement of electrons cannot be used. but when $CuSO_4$ solution in contact with a copper electrode is covered by a $ZnSO_4$ solution and a zinc electrode, care being taken not

II. Predictions of Electrolytic Products

Electrolyte	*Ions Present*				*Cathode*	*Anode*	*Remains in Solution*	
$CuCl_2$	H^+	Cu^{++}	Cl^-	OH^-	Cu	Cl_2	H^+	OH^-
$CuSO_4$	H^+	Cu^{++}	SO_4^{--}	OH^-	Cu	$\frac{1}{2}O_2$	H^+	SO_4^{--}
NaCl	H^+	Na^+	Cl^-	OH^-	H_2	Cl_2	Na^+	OH^-
H_2SO_4	H^+	SO_4^{--}	OH^-		H_2	$\frac{1}{2}O_2$	H^+	SO_4^{--}
KOH	H^+	K^+	OH^-		H_2	$\frac{1}{2}O_2$	K^+	OH^-
KNO_3	H^+	K^+	NO_3^-	OH^-	H_2	$\frac{1}{2}O_2$	K^+	NO_3^-
$Cu(NO_3)_2$	H^+	Cu^{++}	NO_3^-	OH^-	Cu	$\frac{1}{2}O_2$	H^+	NO_3^-
HCl	H^+	Cl^-	OH^-		H_2	Cl_2	H^+	OH^-

III. Supplementary Table of Standard Electrode Potentials (')

$Li \rightarrow Li^+ + e$	+2.96
$Mn \rightarrow Mn^{++} + 2e$	+1.05
$Cr \rightarrow Cr^{+++} + 3e$	+ .71
$H_2C_2O_4 \rightarrow 2CO_2 + 2H^+ + 2e$	+ .49
$Pb^{++} + SO_4^{--} \rightarrow PbSO_4 + 2e$	+ .35
$Ni \rightarrow Ni^{++} + 2e$	+0.23
$Sn^{++} \rightarrow Sn^{++++} + 2e$	0.13
$Cu^+ \rightarrow Cu^{++} + e$	- .17
$Mn^{++} + 2H_2O + 4NH_3 \rightarrow MnO_2 + 2e + 4NH_4^+$	- .47
$Cu \rightarrow Cu^+ + e$	- .52
$MnO_2 + 4OH^- \rightarrow MnO_4^- + 2H_2O + 3e$	- .57
$Fe^{++} \rightarrow Fe^{+++} + e$	- .77
$2Hg \rightarrow Hg_2^{++} + 2e$	- .80
$CuI \rightarrow Cu^{++} + I^- + e$	- .88
$4NH_3 + Zn \rightarrow Zn(NH_3)_4^{++} + 2e$	- 1.03
$2Cr^{+++} + 7H_2O \rightarrow Cr_2O_7^{--} + 14H^+ + 6e$	- 1.36
$Mn^{++} + 4H_2O \rightarrow MnO_4^- + 8H^+ + 5e$	- 1.52
$Ce^{+3} \rightarrow Ce^{+4} + e$	- 1.61
$2H_2O + PbSO_4 \rightarrow PbO_2 + SO_4^{--} + 4H^+ + 2e$	- 1.69

to stir them up, an EMF of +1.1 volts is obtained. The zinc forms the negative pole and the electrode reaction is $Zn^{\circ} \rightarrow Zn^{++} + 2e$. From Table I, it is evident that the sign given there must be reversed, hence at this electrode $E_{\circ} = +.76$. The electrons leave the zinc and travel to the positive pole, the copper electrode, where $Cu^{++} + 2e \rightarrow Cu^{\circ}$. $E_{\circ} = +.34$. The sum of $0.76 + 0.34 = 1.10$ volts. The discharged products (copper metal and $ZnSO_4$) will not react with each other and hence represent a lower state of energy than the original zinc metal and $CuSO_4$, the difference being the electrical energy liberated.

THE LEAD storage cell is an important commercial application of electrochemical theory, since it may be recharged and is fairly resistant to abuse. Its positive pole is lead dioxide, PbO_2, separated from the negative pole of lead by a solution of H_2SO_4. These three chemicals possess considerable chemical energy, and the combination therefore acts as a voltaic cell while discharging, the products being relatively inert: namely, $PbSO_4$ on each electrode and water instead of sulfuric acid. The discharged cell may be restored to the original materials by the application of electrical energy. Thus the common lead storage cell is acting as an electrolytic cell during charging. The half-cell reaction for the positive pole: (on discharge) $2e + PbO_2 + 4H^+ + SO_4^{--} \rightarrow PbSO_4 + 2H_2O$ (reversed from the table) $E_{\circ} = +1.69$ volts. (Note that electrons enter the positive pole). The negative pole reaction is $Pb + SO_4^{--} \rightarrow PbSO_4 + 2e$. $E_{\circ} = +0.35$. Total EMF is 2.04 volts or roughly 2 volts per cell, requiring three cells for a 6-volt battery. On the charge, the electron current is reversed since it is now an electrolytic cell. A common method of testing batteries is to check the density of the electrolyte, a low density meaning that the cell is low in H_2SO_4 and so almost discharged. The addition of H_2SO_4 will not permanently recharge the cell since the $PbSO_4$ electrodes must also be returned to PbO_2 and Pb.

The Edison storage cell employs NiO_2 for the positive pole and iron for the negative pole, the electrolyte being NaOH solution. On discharge the positive pole reaction is:
$NiO_2 + 2H_2O + 2e \rightarrow Ni(OH)_2 + 2OH^-$
$E_{\circ} = +0.49$.

Continued on Page 143

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THE ALCOHOL PROBLEM

Continued from Page 123

Information Sources

ONLY recently in this country has the surface of some of the problems been scratched. There is a very interesting twenty cent Public Affairs pamphlet, written by Herbert Yahraes, entitled *Alcoholism is a Sickness.* This is a ray of enlightenment on a subject too long enshrouded with a cloud of misconception and ignorance. Here is a sane, thorough brief discussion of why people drink, the effects of drinking, how a small percentage of drinkers become alcoholic and a description of enlightened methods of providing for the latter.

The National Committee for Education on Alcoholism, sponsored by the Yale Plan for Alcoholic Studies, publishes free and low cost informative literature on alcoholism, and provides speakers for interested groups. The Research Council on Problems of Alcoholism has sponsored some scientific studies. They, too, concern themselves only with alcoholism. They publish a bulletin and miscellaneous pamphlets and reprints. Though the work of the scientists whom they sponsor is of a high caliber, the limitation of the field of their interest should be kept in mind.

Yale University publishes the *Quarterly Journal of Studies on Alcohol* as well as monographs and books. The University Section on Alcohol Studies of the Laboratory of Applied Psychology maintains two clinics.

A Forward Looking Program

Another sign of progress is displayed in the report of the New Hampshire Legislative Research Commission, earlier this year. They referred to it as a major public health problem. The following quotation from the Report is interesting because it summarizes the general aspect of the problem and indicates an intelligent approach: ". . . the complexity of the problem of alcohol does not permit study of it as a whole but only of its parts and those in such a way as to permit correlations of findings; second, the problem of alcohol cannot be solved by legal enactments alone but requires broad social measures, educational programs, and scientific study and treatment; third, that any solutions proposed for the problem of alcohol must be based on knowledge and research; must be impartial and accurate; and conducted by representative and disinterested people."

It would be worthwhile to finance some competent scientists, psychologists and sociologists to determine whether drinking actually has any social, physiological and psychological value; and, if so, under what conditions as regards the individual, the occasion or the social or industrial circumstances, and the quantity imbibed during a given time, the effects may be considered beneficial. More should be known about the question of why some people become excessive drinkers and why some of the latter succumb to the sickness known as alcoholism. Numerous correlary problems would suggest themselves. Of course, we all have our personal hypotheses about some or all of these questions. But, in this atomic age, we won't be satisfied until we can check these guesses with findings deduced by the scientific method.

IT SHOULD be hoped that our Federal Government would finance a program of study and research such as the one envisaged by the New Hampshire Commission. Some phases of such work could be initiated by the National Mental Health Advisory Commission. The National Science Teachers Association might well urge that such a project be undertaken.

It is interesting to recall that the National Mental Health Advisory Commission was established to carry out the provisions of the National Mental Health Act of 1945, one of the latest among the progressive federal laws initiated during the late presidential administration.

Though there may be a feeling of futility in hoping for appropriations for such a project in the immediate future, I would maintain that intelligent and determined effort is bound to bring fruit in a more progressive era. Such effort must begin now. What do you think?

Comments on recent developments in alcohol education are planned for a future edition. Suggestions will be appreciated by the writer.

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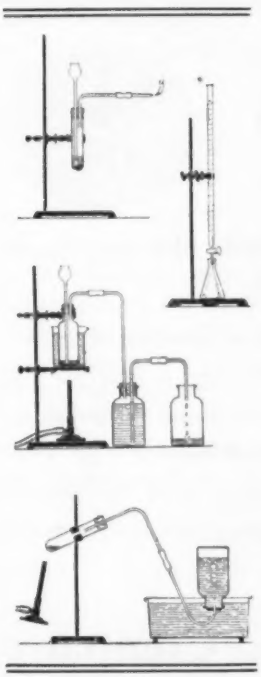

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ADAPTABLE EQUIPMENT

Continued from Page 129

one quickly begins to vibrate in resonance. This can be seen easily if the two are rubbed with white chalk, and it can be heard if the first string is damped a few seconds after plucking. Note how the sound boxes on many musical instruments are shaped to provide sections of various lengths that resonate to various pitches, reinforcing them.

TOY FLUTES and whistles of many types are available in the dime stores and music stores. All may be used to show some of the principles governing vibrating columns of air. In the flutes, and flute type whistles, the length of the column of air is shortened, thus raising the pitch, by uncovering holes toward the mouth end. The number of holes to uncover for each of the four bugle call notes is easily found by trial. In the trombone type whistle, the length of the vibrating air column is controlled by a plunger, and a little practice will be necessary to find true pitches. Note that in all these flutes and whistles, any one length of air column may be caused to vibrate at several pitches an octave apart. The higher octaves require successively harder blowing to supply energy for the more rapid vibration of the air column.

There are several little devices that may be helpful in explaining the nature of sound waves. A line of dominoes, stood on end less than a length apart may be topplled by upsetting the domino at one end of the line. Each domino strikes another as it falls, a process something like the transmission of a sound impulse from molecule to molecule through the air. A similar device consists of a row of marbles in the blackboard chalk groove. When a marble is rolled to strike one end of the row, a marble is dislodged from the other end of the row by the energy transmitted from marble to marble. "Slinky," the flexible steel spring toy, makes a still more accurate analogy. When the spring is stretched out about ten feet long, a few loops can be compressed at one end and, when they are released, the compression wave can be seen to travel the length of the spring—and echo back! However, none of these devices demonstrate the important concept that sound waves radiate in all directions.

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TEACHING OF ELECTROLYSIS

Continued from Page 139

At the negative pole $Fe + 2OH^- \rightarrow Fe(OH)_2 + 2e \qquad E_0 = 0.88$

The total EMF would be 1.37, but under the conditions used 1.2 volts is obtained, requiring four cells for a six-volt battery.

THE DRY CELL is of course not really dry but has moistened salts as electrolytes. The positive pole at the center consists of a carbon rod surrounded by MnO_2 (Note PbO_2 and NiO_2 for the two cells just discussed, i. e. oxidizing agents.) The negative pole is the zinc can covering the cell. (Note here lead, iron, and zinc are reducing agents.) The electrolyte is NH_4Cl and $ZnCl_2$. On discharge at the positive pole $2e + MnO_2 + 4NH_4 \rightarrow Mn^{++} + 4NH_3 + 2H_2O$. E_0 is around 0.5 volt. At the zinc electrode $Zn + 4NH_3 \rightarrow Zn(NH_3)_4^{++} + 2e$. E_0 is around 1 volt; total 1.5 volts.

The dry cell cannot be recharged and is not very long lasting but its convenience makes it valuable.

For a somewhat more extended discussion, the reader may refer to Timm, J. A.. J. Chem. Educ., 24, 160-165 (1947).

VISUALIZING SCIENCE

Continued from Page 131

Plants

Bacteria 2-B-M-S
Spring Wild Flowers of the Open Field 1-C-M
Flower Gardens 2-D-M-S
Thallophytes 11-B-S
Spermatophytes 11-B-S
Forest Fires 2-C-M-S
Gardening Cartoons 2-A-S
Backyard Vegetable Gardens 2-C-M-S

ORDER IN THE DEPARTMENT

Continued from Page 119

But effective science teaching cannot be done with the text alone. What we can do, therefore, to help obtain effective science teaching is to devote some time, thought, and energy in organizing our science departments in such a way as to get the most convenient and effective use from our materials and equipment.

CONSERVATION EDUCATION

Continued from Page 112

TO SECURE cooperative effort the National Committee is inviting interested agencies and organzations to collaborate in securing agreement upon national policies, and the desirable direction of such a program; and to join in sponsoring the work of the Committee in an effort to develop common agreement upon national policies.

To implement such a program the Committee is seeking financial support for a research and study program, to make possible the employment of a research personnel, and to provide for clerical work, travel and publication.

The Committee proposes to work in the following manner: To prepare a preliminary formulation of proposals and suggestions for a national policy in collaboration with agencies, organizations, and individuals. This formulation will be presented at a national conference called for this purpose. From the results of this conference a comprehensive statement on national policies in conservation education will be prepared for publication. The Committee proposes to disseminate this revised statement and assist in its interpretation and implementation, to the end that it may become a vital part in the education of every citizen.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

★

Of *The Science Teacher*, published 4 times per year at Normal, Illinois, for October, 1947.

STATE OF ILLINOIS, County of McLean, ss.

Before me, a notary public in and for the State and county aforesaid, personally appeared John C. Chiddix, who, having been duly sworn according to law, deposes and says that he is the owner of *The Science Teacher* and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse side of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—John C. Chiddix, Normal, Illinois.
Editor—John C. Chiddix, Normal, Illinois.
Managing Editor—None.
Business Manager—John C. Chiddix, Normal, Illinois.

2. That the owner is: John C. Chiddix.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent of total amount of bonds, mortgages, or other securities are: none.

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Sworn to and subscribed before me this 28th day of September, 1947.

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BOOK SHELF

ELECTRICITY — PRINCIPLES, PRACTICE, EXPERIMENTS. Charles S. Siskind, Assistant Professor of Electrical Engineering, Purdue University. McGraw-Hill Book Company, New York, 1947. 448 pages. 13x21 cm. 189 illus. List, $2.60.

This book deals with elementary magnetism and both direct and alternating current electricity. It is suitable for senior high school and non-electrical engineering college students.

Mathematics has been kept to a mimum with simple arithmetic formulas the rule where problems are necessary. Diagrams are simple, well explained, and easy to read. Pertinent experiments with clearly stated objectives and well described procedures are found in each chapter. At the end of each chapter is a summary in well-worded statements. Following the summary are a number of questions and well-selected practical problems. Construction projects are also sugested and described. At the end of the book is a list of visual aids for each chapter.

LECTURE EXPERIMENTS IN CHEMISTRY. G. Fowles. Third Edition with Supplement. The Blakiston Company, Philadelphia, 1947. 612 pp. 13½x21 cm. 158 illus. $7.00.

The third edition of this excellent book of teaching demonstrations has been enlarged by the addition of a supplement (18 pp.) of new material.

Of particular note is the attempt to deal experimentally with the principles of chemical action equilibria. The material is in teaching order and can be effectively used for illustrative purposes. Other additions include Mattuck's conductivity apparatus and modern methods of cleaning mercury.

The book supplies a wealth of demonstration material for use in college teaching. Much of the material also will be found valuable in high school chemistry.

BASIC BIOLOGY FOR HIGH SCHOOLS. Carroll Lane Fenton, and Paul E. Kambly, Professor of Education and Director of Supervised Teaching, University of Oregon. The Macmillan Company, New York, 1947. 726 pp., 15x20½ cm. Illus. $3.24.

Basic Biology is a text that will attract even the student who has not yet found his interest in the subject. Included in the text are eleven units, divided into from three to six chapters each and a twenty-page glossary. An organization of all sections of the book has been adopted which develops each subject logically from material that precedes it.

Each unit is introduced with a full-page plate of pictures illustrative of what the unit will present, followed by a page of descriptive material and challenging questions. The chapters are written rather informally in a manner suggestive of a skilled instructor talking with his students.

The numerous pictures are especially splendid, each illustrating a fact or principle being discussed in the text itself. Ranging in size from small sketches up to full-page plates, they are of a calibre to invite even the experienced instructor.

The text will no doubt find ready acceptance on the part of teachers. A workbook is also available to accompany the text.

DIRECTED EXPERIMENTS IN CHEMISTRY. Theodore E. Eckert, Whitney Point Central School, Whitney Point, N. Y.; Harley K. Lyons, Walnut Hills High School, Cincinnati, Ohio; and Wallace H. Strevell, Ellenville Public Schools, Ellenville, N. Y. College Entrance Book Company, New York City, 1947. 158 pp., 18x25½ cm. Illus.

Directed Experiments in Chemistry is a laboratory manual of unusual flexibility, well suited to the requirements in practically all states. In addition it contains exercises that may be used to introduce an experiment, as a summary at the end, or for more effective class work.

Some of the desirable features include: (a) recording of data in a column separate from and adjacent to the print, making it easy for the teacher to check and the student to study to draw conclusions; (b) concluding questions serve to tie up the experiment with the work in the text; and (c) the book is adaptable to a short or long period. For a short period of laboratory, some or most of the concluding questions may be done outside the laboratory or omitted.

A section is included on qualitative analysis and attention is given to drills for formula and equation writing and for chemical arithmetic.

LABORATOORY AND CLASSROOM EXERCISES IN GENERAL CHEMISTRY. B. Smith Hopkins, Professor of Chemistry, Emeritus, University of Illinois; Therald Moeller, Assistant Professor of Chemistry, University of Illinois; and Frank B. Schirmer, Jr., Assistant Professor of Chemistry, Clemson Agricultural College. D. C. Heath and Company, Boston, 1946. 244 pp., 20½x27 cm., 31 figures. $2.00.

Laboratory and Classroom Exercises in General Chemistry is a laboratory manual for the first year course in general chemistry in college. It is adaptable to the varying requirements of the instructor and the needs of the class.

In organization, the experiments follow the usual plan in most texts. More than enough experiments are included and the instructor may omit some of the easier ones without destroying the continuity of the work.

A brief plan of qualitative analysis is included that is adequate to meet the needs of the brighter student or for special work for the class

SCIENCE THROUGH EXPERIMENT. Charles H. Lake, Superintendent of Public Schools, Cleveland, Ohio; Louis E. Welton, former Head of Science Department, John Hay High School, Cleveland, Ohio; and James C. Adell, Chief, Bureau of Educational Research, Public Schools, Cleveland, Ohio. Silver Burdett Company, Chicago and New York, 1947. 264 pp., 20x26 cm. Illus. $1.24.

Science through Experiment is unique as a general science workbook in that it is based on experimental work. Students "learn by doing." Part of the experiments may be done by the pupils and part by the teacher as demonstration work. An extensive list of references to texts is provided with each unit so that the course may be handled on a laboratory-library basis, if it is desired. Questions are included to lead the pupil to reason from observations and facts; draw conclusions; and obtain an understanding of principles. Many questions are provided at the end of each unit to direct the outside reading and stimulate thought. A vocabulary list is also provided.

The fifteen units selected for this laboratory work book comprise those things of science usually considered to be of most importance to the ninth year student. A teacher's manual, including tests, is available.

APPLIED CHEMISTRY. Revised. Sherman R. Wilson, Head of the Exact Science Department, Northwestern High School, Detroit, Michigan; and Mary R. Mullins, Chairman of Physical Science, Midwood High School, Brooklyn, New York. Henry Holt and Company, New York, 1947. 714 pp., 13x20 cm. Illus. $2.36.

Applied Chemistry is written to meet the need for a text for the large group of students who do not expect to study college chemistry and yet want some knowledge of the subject. The text, while em-

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176 Pages, Printed.....$1.85

Biology Projects

(Published, October, 1942)

Included among these projects are: loss of soil elements by leaching, test tube plants and root hairs, food elements of plants, how to make a cross section of a stem, using light to make glucose and starch, when plants breathe like people, heat of respiration in plants, what causes liquids to flow in plants, identification of trees, the house fly and what he carries, controlling insect pests, digestion, checking your posture for health, charting your teeth, susceptibility to tooth decay, making media of correct pH to grow bacteria.

47 Projects, 100 pages, mimeograph $1.25

General Science Projects

(Published, October, 1942)

Among the projects are the following: amateur range finding, how to navigate by sun and stars, weighing without scales, making and using solutions, seven ways to start a fire, seven ways to put out a fire, chemical indicators, a rock mineral collection, a pin hole camera, printing pictures, learning to be a radio amateur, a pendulum project, testing foods at home, digesting food with saliva, canning food, how good are the arches in your feet, surveying the teeth, and clay modeling and casting.

34 Projects, 95 pages, mimeograph $1.25

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phasizing social and cultural values, does provide a good knowledge of the fundamentals.

The difficulties of formula and equation writing and problem solving are reduced by greatly limiting the requirements of the former and postponing the latter until the second semester. The theory of ionization is largely limited to a brief discussion in the appendix to be used or not as desired.

The new revised edition has been brought up to date by the addition of new material in fields where there has been great technical advances. It covers such items as sulfa drugs, penicillin, DDT, synthetic rubber and new alloys.

Also included in the text are laboratory experiments and a suggested list of projects accompany each unit.

WORKBOOK FOR SCIENCE ON THE MARCH—BOOK ONE. Curtis Love, Head of Science Department, Pine Bluff High School, Pine Bluff, Arkansas; and John A. Clark, Head of Department of Physical Science, Alexander Hamilton High School, Brooklyn, New York. Houghton Mifflin Company, Boston, 1947. 170 pp., 20x27½ cm. 135 figures.

Workbook for Science on the March, Book One, by Clark, Fitzpatrick and Smith meets the need for a workbook in general science area. Although it parallels the text for which it was designed, it can be used with other similar texts.

The problems making up the units in this book are particularly well directed toward specific challenging and practical goals. In each problem are two or more problem questions for thought, followed by a summary. Each unit closes with a section entitled "Learning to Work as a Scientist" in which the student may learn the procedures and practices of scientific thinking. At the end of the book is a special section of the "Methods of a Scientist."

Tests to accompany Science on the March, Book One, are available.

HEALTH INTERESTS OF CHILDREN. A staff research Study. Denver Public Schools, Denver, Colorado, 1947. 121 pp. Illus. $1.25.

This is a report of a research study of the health interests of 3,600 pupils in the Denver Public Schools. Opinions of parents and teachers are included. Also the book summarizes health needs of children as identified by experts in the field. Some of the eighteen areas in which data has been organized are: keeping physically fit, group health, cause of disease, protection from disease, stimulants and narcotics, personality development, social health, first aid, and vocations in health.

Teachers interested in this field will want to know the implications from this study and what is being done through the curriculum of the Denver Public Schools. Copies of the report may be obtained by sending an order to the Department of Instruction, Denver Public Schools, together with a check for $1.25 made to the Treasurer, School District No. 1.

HOW TO STUDY PHYSICS. Seville Chapman, Assistant Professor of Physics, Stanford University, California. Stanford University Press, Stanford University, California, 1946. 28 pp. Paper cover. $.25.

The areas covered include *Study Suggestions, How to Take Notes, How to Work Problems, Mathematics in Physics, and Studying for Examinations.* The author believes that every suggestion in the book has been of help to someone.

The book should be of much help to college freshmen studying physics.

ANNOTATED BIBLIOGRAPHY ON ATOMIC ENERGY. Israel Light. Bureau of Publications, Teachers College, Columbia University, New York, 1947. 29 pp., 21x27 cm. $.35.

This bibliography lists books, pamphlets, periodicals, documents, and a special series of materials from other sources that deals with atomic energy. One section lists material on "Science and Society." The kind and type of material is usually indicated.

EDUCATORS GUIDE TO FREE FILM. Seventh Annual Edition. Mary F. Horkheimer; and John W. Diffor, Visual Education Director, Randolph High School, Randolph, Wisconsin. Published by Educators Progress Service. 351 pp., 21x27½ cm. $5.00.

The 1947 revised edition provides a wide selection of educational movie film and slide film with annotations to guide the teacher in the selection of those that meet their needs. Of the 1,448 titles listed, 425 are new. Films that have been discontinued during the past year have been deleted. The areas covered are applied arts, fine arts, health education, science, and social studies. Teachers of science will find biology, chemistry, general science and physics treated separately. This will be found a worthwhile service.

ATOMICS FOR THE MILLIONS. Dr. Maxwell Leigh Eidinoff, Queens College Department of Chemistry; and Mr. Hyman Ruchlis, Lafayette High School, New York. McGraw-Hill Book Co., New York, 1947. 281 pp. Illus. $3.50.

This surprisingly clear and non-technical book traces the development of atomic energy from ideas in early Greek concepts through the discovery and application of atomic fission. It is factual, up-to-date, and has the style and thrill of a novel. It is replete with striking analogies and clever illustrations. *Atomics for the Millions* will satisfy the need felt by many teachers who want to keep abreast of current knowledge in atomics, as well as the curiosity of the young student.

This book is the fortunate result for which one would hope from the teamwork between a scientist and a teacher. Dr. Eidinoff has a background of experience in the wartime atomic projects. Mr. Ruchlis is well known among his colleagues as an ingenious teacher.—J. S.

Deetz, Charles H., CARTOGRAPHY—A Review and Guide for the Construction and Use of Maps and Charts. Special Publication No. 205 (Second Edition), USDC, Coast and Geodetic Survey. 85 pages, 1943. Superintendent of Documents, 65 cents.

A careful presentation of map making, including historical development, classification and analysis, compilation of materials, map projections, defining directions, construction techniques, and illustrations. This would be a useful reference for secondary school teachers, and it would also prove helpful to students who wished to study the development of maps.

Fickes, Clyde P. and Groben, W. Ellis, BUILDING WITH LOGS. Miscellaneous Publication No. 579, USDA, Forest Service. 56 pages, 1945. Superintendent of Documents, 15 cents.

A thorough discussion of how to build logs complete with helpful illustrations showing details to be considered. The treatment begins with foundations and includes construction, flooring, chinking, framing and painting. The specifications for furniture made from logs would be especially valuable to persons interested in projects involving the making of stools, chairs, beds, chests, tables, and the like.

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